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ABSTRACT

A multi-disciplinary approach to environmental studies for high school students, combining the areas of earth science, social science, and health education, is developed in this guide. Student Action for the Valley Environment (SAVE) is primarily a simulation program concerned with a serious problem of today--the survival of life in the cities. It encourages student awareness, role playing, and problem-solving by having students propose and decide on alternate ways of structuring a new city, with their final plan compared to that of the actual city of Phoenix, Arizona. The nine-lesson approach outlines for each lesson its aim, procedure, materials needed, time allotment, supplementary materials, and future assignments. Lessons concentrate on a study of the urban environment through "Conflict," a simulation game, site features, city design, the concept of change, population, land use, and the development of a model city. Numerous enrichment activities are suggested and elaborated upon, greatly enhancing the unit and promoting its usefulness in an interdisciplinary instructional program. These cover a wide variety of environmental factors and considerations. A data bank or background information about Phoenix is also included. This work was prepared under an ESEA Title III contract for Project Outreach. (BL)

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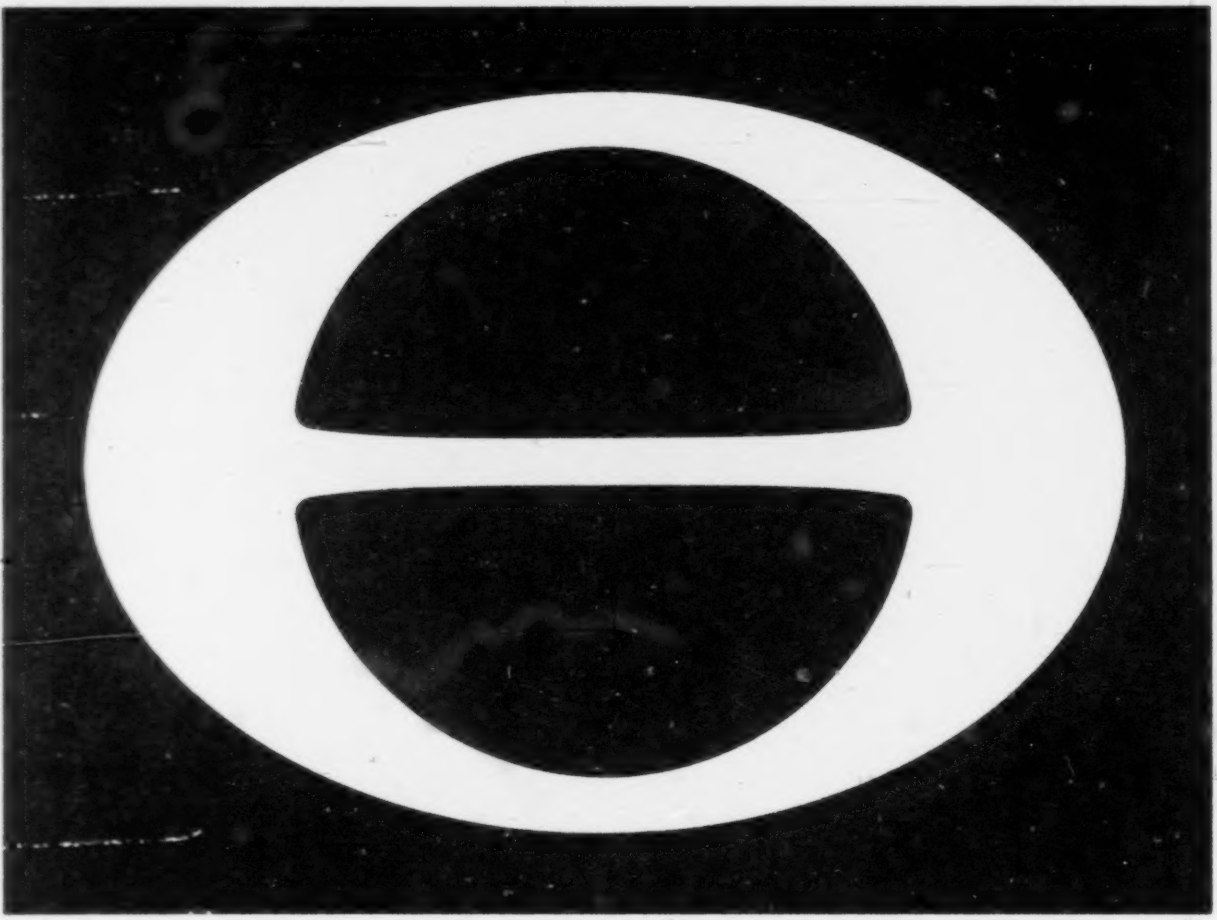

VALLEY ENVIRONMENT

SAVE

SE 016 607

ED 081601

Student Action For The Valley Environment

(SAVE)

A multi-disciplinary approach to Environmental Studies for high school students combining the areas of Earth Science, Social Science and Health Education.

Prepared by

Project Outreach

An Environmental Education Program

of the

Phoenix Union High School System

Phoenix, Arizona

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ABSTRACT

Man is separated from all other animals in his unique ability to affect his environment. He is not forced to withstand the hardships of adverse weather, endure prolonged periods of hunger and thirst, and in constant peril from disease or predators. Man alone can create his own environment and since he is a gregarious creature he has developed a unique establishment called a city.

At the present time 70% of the people in the United States live in an urban situation and trends indicate that this percentage will increase. If man is to achieve harmony with his fellow man and with nature, then the concept of city living with all its many facets, both physical and sociological, must be studied, understood and perfected to the highest degree.

Phoenix, a mere youngster among cities in its 100 years is on its threshold of a second century of growth. It may follow the course that other cities have followed leading to decay and urban blight or it may begin to grow and prosper in an orderly fashion. Desirable growth will be the result of the influence of an educated populace, aware of all the problems a city environment poses. It is to this end that the following program is aimed.

INTRODUCTION

SAVE is an educational simulation program designed for use as part of most high school courses. The program portrays, in simplified form, some serious environmental problems, confronting students with some of the dimensions of these problems and engaging them in an effort to develop their own solutions.

SAVE provides exciting and practical classroom learning experiences, as students propose and decide on alternate ways of structuring a new city. The class's final plan is compared with the actual city of Phoenix, Arizona.

The simulation provides a foundation to build upon and develop into a much larger unit of study and time period, or preferred parts may be used independently.

A focus on environmental education is needed, one that will bring the student and his environment into a "real life" encounter for understanding.

Therefore this program is an attempt to provide a framework of important ideas which may be helpful to educators at all school levels in developing meaningful classes concerned with environmental education.

The student completing this activity should be better able to transfer data about city problems from abstract form to practical application. The experience of building a model city should result in a subtle change in a students' outlook. Instead of being overwhelmed by the city's complexity, he should see the city as a whole in relationship with the environment.

We propose that if the student acquires particular broad environmental understanding he will develop social conscience that will affect his behavior toward the total environment. Therefore SAVE has developed this integrated, interdisciplinary instructional program in environmental education, designed to promote an environmental awareness.

The learning is achieved not only through the use of written materials but mainly by communication among the students. The teacher has the important task of encouraging and motivating participants to become involved in the program. The teacher will want to participate actively in the simulation, encouraging discussion and bringing up questions that have a relationship on the program. SAVE is an opportunity for teachers and students to join in the excitement often sought in an educational experience.

SPECIAL NOTE TO TEACHERS

There are no evaluation devices included in the SAVE program for the following reasons:

1. The training and background of the teachers using the materials will vary.
2. The maturity and subject matter understanding of the students will differ depending upon the group using the materials.
3. Due to the flexible nature of the program, a teacher may wish to delete any portion or portions he desires or add supplementary units.

If a teacher so desires he may wish to employ outside assignments such as reading, question sheets or written reports. Tests, both objective or subjective, may easily be constructed if the teacher so chooses. One should keep in mind that creative thinking, attitudinal changes, openmindedness and group cooperation are not easily graded by a series of exams and homework.

It will be necessary for the teacher to duplicate certain materials from this booklet for distribution to the students as needed.

KNOWLEDGE OBJECTIVES

A. To be aware of the problems involved in providing an adequate water supply for industrial, recreational areas and uses.

B. To become familiar with the physical features of the land such as topography, climate, soil conditions, and natural drainage areas.

C. To recognize the various types of wastes produced in an urban area such as sewage, solid trash and air pollution and suggest steps to be taken for their porper disposal and control.

D. To conduct an investigation of the current land utilization within the city and appreciate the need for an orderly pattern of growth.

E. To be able to predict future population growth and distribution patterns based on present trends and past data.

F. To develop an appreciation for the aesthetic value of developing a city that harmonizes within the natural environment around it showing how such things as green belts and architectural design play a role in achievement of this goal.

G. To be aware of the problems involved in moving people and goods based on present population distribution and existing traffic facilities.

H. To be aware of the vast array of services such as health, police and fire protection-education and recreation that the city has a responsibility to maintain.

I. To recognize that a dynamic consumer market is vital for the economic well-being of an urban community--

J. To know that every human activity depends on the integrity and proper functioning of the ecosystem.

K. To know the causes and characteristics of problems of the deteriorating environment and be able to suggest realistic sollutions.

L. To know that protection of the environment must be a cooperative effort between the people and their government.

M. To encourage participation in the community through social, economical, recreational and political action.

N. To provide alternatives of choice, both practical and idealistic, in the decision making process.

O. To relate school life to real life.

CONDUCT OF THE SIMULATION

How you use the activity and which, if any, parts you eliminate, will depend on the needs of your class, your time limitations, the length and schedule of class sessions in the school, as well as discussion generated by the students involvement. The teacher may want to devote more than one class session to a particular phase of the program in the event that the students need more time or leave out some of the program in favor of other parts.

The teacher's role is that of a guide and adviser.

The class should be divided into groups of 3-6 students. The final objective of each group is to develop a model city.

Students should be shown the "Phoenix 1990" map and given some orientation to it before they begin to use it as a base for constructing their model city. (See Fourth Lesson.)

On the first day, SAVE is introduced and explained to students. They receive materials and assignments, ask questions and discuss procedures.

A flexible attitude should be encouraged so that students do not judge the solutions of others as wrong because they do not conform with their own solutions. If students can justify their decisions, their solutions should be accepted.

The learning experience will be most successful when the class has acted on its own responsibility, and when the teacher has been flexible in adjusting to the project as it progresses.

CLASSROOM LAYOUT

If only a single classroom is available the playing area should be divided into sections by grouping desks together, or chairs around work tables. Players should be allowed as much freedom of speech and movement as possible without interfering with the work of other groups. No special student preparation is required, as much of the education value of a simulation like this is the result of students learning from each others ideas and from the resource materials.

MATERIALS

1) The teacher will provide appropriate material for each group from the SAVE booklet. In addition, each group will be provided with 2) a Phoenix 1990 Comprehensive Plan, 3) three large sheets of paper approximately 30" x 40", 4) colored pencils, 5) the following supplementary materials should be readily available in the classroom.

Inside Phoenix 71 (Retailing)
Inside Phoenix 71 (Economy)
(available from the Phoenix newspaper, also all P.U.H.S. libraries have copies.)

The Central Phoenix Plan available from City Planning Commission.

MATERIALS (Cont'd)

Arizona Statistical Review. Available from Valley National Bank.

Environmental Education Catalog, Project Outreach, Phoenix Union High School System, complete lists of films, books, filmstrips, materials.

additional topographic maps may be purchased from the United States Geological Survey, Washington, D.C. 20242. The U.S.G.S. has a special map series for major cities called the Metropolitan Areas Map Series that cost $2 a sheet. [illegible] are free upon request.

Open Space Plan for the Phoenix Mountain. Summary Edition.
City of Phoenix Planning Commission

Phoenix Magazine, Issue, July 1971.

FIRST and SECOND LESSON:

Aim: To provide an innovative approach to stimulate the students thought in relation to the urban environment. This will serve as an informal method of gaining student confidence and participation for subsequent introduction of the SAVE program.

Approach: Students will play "Conflict".

Materials: The game "Conflict", is found on the next fourteen pages.

Time Allotment: Two class sessions (Minimum)

Supplementary Materials: None

Assignment: None

CONFLICT

Principles Involved in this Exercise:

CONFLICT is designed to teach students this principle of ecology:

> "All elements of the environment are interrelated and interdependant. When a man changes the environment, it has consequences not only for himself, but for other forms of plant and animal life, and for the soil, air, and water."

CONFLICT will help the students in your class understand this interdependence of man with his environment. Equally important, it will enable the student to weigh the advantages and disadvantages of changing the environment and to make decisions about what kind of environment they want for themselves.

A brief description of the Exercise:

CONFLICT is played using a land use map of Phoenix which shows existing physical and man-made features.

At the beginning of the exercise, each student is assigned a role. It may be a human role, such as commercial interests or a farmer, or it may be a natural role such as a cactus or roadrunner, or it may be a basic resource role, such as air or soil.

The students are presented with a series of proposals about adding various man-made features to the map, such as an airport expansion or a shopping center. The students discuss the possible consequences from the viewpoint of the roles they are playing.

If a majority of the class votes to add the feature, a model of it is placed on the map, along with the given number of "Population Units." These units represent additional people moving into Phoenix because of the construction.

Throughout the exercise and after it is over, the teacher can initiate discussion about the interrelationships of man with his environment: For example, if the group has voted to build everything proposed, all the farmland will have been erased. Where is the oxygen to come from? Are there any natural areas for wildlife and outdoor enthusiasts?

HOW MUCH TIME WILL IT TAKE

If the class were to play straight through from beginning to end, it would probably consume a minimum of one hour and a maximum of four to five hours depending on the amount of discussion you stimulate. Some teachers may wish to plug in a unit on industry, agriculture, or economics before a vote is taken on each feature.

MATERIALS USED TO PLAY CONFLICT

1 land use map of Phoenix

10 Project Proposal Sheets (see score sheet for their names)

13 Team Identification Cards (see score sheet for their names)

1 pad of score sheets

20 drawings of the Project Proposals along with a dump, sewage disposal plant and eight population units.

HOW TO PLAY CONFLICT

1. Explain that the class is going to participate in an exercise called CONFLICT. In the exercise they're all going to have a chance to decide on what kind of city they'd like to live in.

2. Place the Phoenix land use map in front of the class so everyone can see it. Point out some of the existing physical and man-made features.

3. Explain that the map represents a complete, self-contained world. Food, air, and water must come from the immediate area and no solid liquid or gaseous waste may be taken off the map.

4. Show the students the Project Proposal Drawings and put the name of each on the chalkboard so they may decide which project they will discuss first.

5. Divide the class into thirteen (13) teams: desert, farmers, unemployed workers, etc., and distribute the cards to the teams. Remind them that they are to think and respond as they feel the role they are representing would respond. Explain that each team will meet and will have one vote when the time comes.

6. Hold up the Project Proposal Drawing that the students have selected to discuss and place it on the map. The location of many of the pieces is not critical and the students could actually help decide its placement.

7. Read the material on the Project Proposal sheet including the "Effect of Population" portion explaining to the students that Population Units represent additional people attracted to Phoenix by the construction of the proposed project. Your students may want to add other facts about the project concerning what effect the project would have on them.

8. Next, have the teams discuss among themselves whether or not they're in favor of building the project. Set a time limit of three or four minutes for discussion although after a while they probably will not need that much time.

9. When the time is up have a spokesman for each team tell how his team is voting and a brief comment as to why they are voting that way.

10. Appoint someone to be record keeper and call out each team's name before they vote and to record and add the votes. If a majority of the teams want the project leave its drawing on the map along with any population units that may go along with it. If they decide not to have the project remove the pieces from the map.

11. Show the next Project Proposal Drawing and proceed as before. At this point you may wish to choose a student to be a monitor and take your place. The rest of the game can be run by students.

12. Whenever a total of three Population Units have been added to the map then a Dump and Sewage Treatment Plant must be added to take care of the added population. Its up to you to decide whether to surprise them with this when they have reached this point or warn them beforehand. If you do not warn them and they become disturbed about adding these features this is a good time to discuss the need for adequate advanced planning for the city's future growth. Remind them that as the exercise continues an additional Dump and Sewage Treatment Plant will be added for every three Population Units.

13. Continue with the exercise until you reach "the end." The end may come when a) the students tire and lose interest, b) all of the projects have been considered.

Supplementary Ideas.

A. After a few rounds of voting some students will probably note that certain groups always tend to vote "Yes" while others consistantly vote "No." To add interest have the students change cards and assume a new role.

B. Before too long, some student or perhaps you will mention "Who ever heard of a 'Cactus' voting?" or "Teenagers aren't old enough to vote!" At this time you can take away the non-human role cards and permit only real people to vote. It will be quite evident what trend will now occur. This will be a good time to ask who does. Look out for the Air or Soil or the Desert?

C. This exercise may be extended to last for several weeks, Outside reports and research may be done concerning each of these projects. Surveys among the members of the class as to their own personal feelings can be taken. These surveys may be enlarged to sampling other students in the school or a neighborhood sampling. The imagination and ingenuity of the class and teacher are the only limitations as to how far one can go.

CANALSIDE PARK SYSTEM

Description and Environmental Impact Facts:

1. The existing Salt River Project canal system would become open to the public by providing easy access to the canal banks.
2. Bicycle paths, picnic tables and playground facilities would be constructed along the canals.
3. Fish could be stocked in the canals and children and adults who enjoy fishing could do so without driving many miles to the lake.
4. Drownings would be more common since children would be tempted to swim in the canals even more than at present.
5. Some type of police force would have to be established to keep people from abusing the privilege of using the canals.
6. The maintenance of the parks would be quite expensive and city tax money would have to support it or else it would be a paying proposition with admission fees going to Salt River Project.
7. People will throw trash and garbage into the canal and this will pollute the water and may make it unfit for irrigation purposes.

Effect on Population:

This beautification project will attract prospective residents to Phoenix. If you decide to build this project add one population square.

PRO FOOTBALL STADIUM

Description and Environmental Impact Facts:

1. The stadium will provide recreation for the people who enjoy watching football games.
2. It will create new jobs for people providing services for the fans.
3. On game days traffic will be heavy in the area. There will be a lot of noise and litter.
4. A citrus grove will be replaced by the stadium.
5. On game days students can work as vendors and earn extra money.
6. The stadium will be paying taxes to the city. The money can be used for many purposes.
7. Many more tourists will be visiting the city and spending money in our local stores.

Effect on Population:

People who enjoy sports will be attracted to the area and make their homes here. Add one population square.

RIO SALADO PROJECT

Description and Environmental Impact Facts:

1. A dam will be built at the southwest end of Phoenix in the dry Salt River bed.

2. The dam will serve as a flood control device and carry off excess surface water from our occasional rains.

3. Water will become a permanent fixture in the river bed not a flood time oddity.

4. Tree lined lakes and lush green parks with walking paths, horse and bike riding trails, boat docks and picnic pads will be developed.

5. The city would be united by a common beauty spot instead of being split by a desolate rock pile.

6. The water flowing down the river bed would be diverted for use in presently irrigated farmland and reclaim from the desert more rich farmland.

7. Boating and other water recreation activities would be easily accessible to all valley residents.

8. A great deal of tax money will be required to finance such an undertaking.

9. Excess boat fuel, oil and litter will be thrown into the river and pollute the water.

10. Tourism will increase because of the scenic water way.

11. Many industries and homes near the present river bed will have to be moved elsewhere.

Effect on Population:

Tourists will become permanent guests and the city will grow. If you decide to add this project, add two population squares.

AIRPORT ENLARGEMENT

Description and Environmental Impact Facts:

1. The enlargement will enable more people and products to enter and leave Phoenix faster and easier.
2. Because we will be tied closer to the major cities on the West Coast our commerce will increase.
3. New industries will be attracted to the Valley creating more jobs.
4. Tourism trade will increase since more people will be visiting.
5. Many houses in the immediate vicinity will be torn down and the people living there will have to be relocated.
6. Businesses and residents in the area will be bothered by the increased noise.
7. Air pollution will increase not only from the additional planes but with all the extra cars in the area.
8. The city jail will have to be moved to some other part of town.
9. Some cotton fields and citrus groves will be paved to make runways and parking lots.
10. Additional tax money will be coming into the city not only from the airport facility but from the other industry it will attract.

Effect on Population:

Due to the increased commerce and industry in the Valley more people will be seeking their homes here. Add two population squares.

INDUSTRIAL PARK

Description and Environmental Impact Facts:

1. The industrial park will be an area where many manufacturing plants and warehouses will be located. These industries will make a variety of products.
2. The city will grow through the many jobs created and more money will be spent.
3. The new businesses will be paying taxes to the city.
4. The unused desert land southwest of the city will be cleared and paved for the location of the buildings.
5. Products and goods made locally may be cheaper and more plentiful because they are not shipped a long way.
6. Cars and trucks in the area, in addition to the industries, will add to the air pollution.

Effect on Population:

These industries will attract many new residents. Three population squares must be added.

SHOPPING CENTER

Description and Environmental Impact Facts:

1. The additional businesses will create more money: city stores can branch out into new areas.

2. The shopping center will need store managers, clerks, and many other kinds of people to run it. Many jobs will be created.

3. The stores in the shopping center will be selling many kinds of products to people in the area. Without the shopping center it would be difficult for people in the area to buy these products.

4. People in the area will go to the shopping center instead of driving to the city. This means that they will be driving less, burning less gasoline and so there will be less air pollution.

5. The area taken up by the shopping center will replace many acres of cotton.

6. Traffic will be quite heavy and residents near the area will be annoyed by the additional noise and litter.

Effect on Population:

The shopping center will be a great convenience for many people. Because of this, local real estate men and land owners will build nearby. This housing will attract new people to the area. If you build a shopping center, add one population square.

NEW FREEWAY SYSTEM

Description and Environmental Impact Facts:

1. It will be easier to travel to the west coast cities of Los Angeles and San Diego.

2. It will provide a safe, efficient, fast, economical and convenient method for transporting people and goods from one place to another.

3. It will take the strain off our present system of streets and highways, therefore, people traveling short distances will be able to do so in a more relaxed manner.

4. One lane of a freeway will carry three times as much traffic at twice the speed and three to five times safer than one lane of a major street.

5. There will be more jobs in the city. People will be hired to build the highway and after completion people will be needed to work in the motels, gas stations and restaurants near it.

6. People owning land where the freeway is to be built will be able to sell it for a good price. Many slum homes will be torn down and the people will have to be relocated.

7. The highway will cut through some nice areas of town. Some citrus growers and cotton fields will be replaced but there will be landscaping alongside the highway.

8. People living near the freeway will be annoyed with the noise and litter that will be associated with the increased traffic in their neighborhood.

9. With more cars and trucks moving about air pollution will increase.

Effect on Population:

People who enjoy our low density, low profile city will be attracted to move into our city since they can move about easily. Add one population square if you decide to build it.

PHOENIX MOUNTAIN PLAN

Description and Environmental Impact Facts:

1. Several thousand acres of mountainsides will be preserved in their natural state.
2. No houses, stores or highways will scar the native beauty of the slopes.
3. Hiking, camping and picnicking will be popular in this rugged area.
4. Flat fertile farmland in the Valley will have to be used for home building since housing will not be permitted on the mountain slopes.
5. Those people who desire a home with a view will not be able to live on the mountain and the so called elite part of town will have to be on level land.
6. Bike trails and walking paths will be established.
7. Tax money will be used to buy the land and maintain the **facilities**.
8. No revenue will be coming into the city since no houses or businesses will be built there to pay taxes.

Effect on Population:

If you decide to complete this project add two population squares since housing will have to be built in the valley and mountain land can't be used.

HIGH RISE APARTMENTS

Description and Environmental Impact Facts:

1. The high-rise apartments will permit a lot of people to live in a small area.

2. They will provide newer and better homes for more people.

3. The high density population units will not require a large amount of area thereby allowing the nearby land to be used for other purposes such as parks, stores, and industry.

4. With many people living in one general area mass transit can become a practical means of moving people from place to place. There will be less automobiles on the highways and thereby less air pollution.

5. Children living in the apartments will have no yards to play in and parents will not have to spend time cutting grass and other home maintenance work.

6. Building and servicing the apartments will create many new jobs.

7. The new residents will be spending a lot of money in the local stores and the city will get tax money from the residents and apartment owners.

Effect on Population:

Since the people will be living in the apartments they will not take up space outside of the apartments. If you decide to build them, add no population units.

CENTRAL PHOENIX PLAN

Description and Environmental Impact Facts:

1. High rises development will be restricted to the Central Avenue corridor and the Governmental mall complex in the down town area.

2. This project will revitalize the down town area and attract businesses into the center of town.

3. Many new jobs will be created with the building and maintenance of new structures.

4. Traffic may be congested with people working and shopping in the down town area.

5. Single family residences, many of which are good examples of early architecture in the area, will be torn down to make way for parking lots and modern buildings.

6. The down town area will be noisy and dirty with increased usage.

7. Fire and police protection may become difficult with the high density of people in one general area.

8. Mass transit could become a possibility since we will have a large number of people going to one area.

9. New business will be attracted to the Valley because of the convenience of everything being located close by.

Effect on Population:

If you decide to build this project add one population square since more businesses will be moving into the Valley.

Score Sheet	Rio Salado Project		Freeway		Industrial Park		Shopping Center		Canalside Park		Central Phoenix Plan		Pro Football Stadium		Airport Enlarge-ment		High-Rise Apartments		Phoenix Mountains Plan	
	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
Water																				
Farmer																				
Commerical Interests																				
Air																				
Migrant Worker																				
Teenagers																				
Soil																				
Real Estate Developer																				
Cactus and Roadrunner																				
Industrial Worker																				
Desert																				
Unemployed Worker																				
Recreational Interests																				
TOTALS																				

INTRODUCTION FOR STUDENTS

SAVE is concerned with the most serious problem facing our country today -- the survival of life in the cities. This simulation will give you a chance to work on this problem putting your imagination and knowledge to active use as you try to design your own city plan. As a citizen you will have to face the city's problems whether or not you actually live in a city. Life in one part of our environment affects life in all parts of the environment. SAVE will give you an opportunity to prepare for the future by understanding the problems our cities have now!

These urban problems are the same you encounter everyday: crowded streets, lack of parks and playgrounds, poverty, unemployment, crime, disease, run-down buildings, and pollution. Your decision will be limited by the physical environment and the population make-up of a city that already exists; Phoenix, Arizona. A city unique in character, but with all the problems that can be found in all cities in the United States. When you have completed the project you will understand much more about our city's problems, and you will be familiar with the ideas that have to be considered in solving these problems.

THIRD LESSON

Aim: To provide a general understanding of the simulation process and to familiarize students with Phoenix site features.

Approach: The teacher will introduce the unit, select the groups and describe the rules or any changes. (See Page 4.)

At this time the teacher may wish to introduce the simulation by use of a film(s) such as Valley Beautiful - Valley Ugly or The Party's Over.

A large Phoenix 1990 map should be in view for the entire class to view from the very first session. Each group will need the same type map to complete this exercise.

Groups should be asked to located the following on their individual maps.

1. Camelback Mountain
2. Phoenix Mountain
3. South Mountain
4. Papago Park
5. Salt River bed
6. International Airport
7. Black Canyon - Maricopa Freeway
8. Central Avenue
9. Arizona - Grand Canal
10. Southwest Industrial Reserve
11. Railroad trunk lines
12. Your high school

Materials: Valley Beautiful - Valley Ugly -- available from the Arizona Bank.
The Party's Over -- from Maricopa Chapter of the A.I.A.
Project Outreach - equivalent film from Outreach resources.
Phoenix 1990 Map
Student hand-out listing site features to be found on map.

Time Allotment: One class session

Supplementary Materials: None

Assignment: None

FOURTH LESSON

Aim: To aquaint students with Phoenix site features.

Approach: In preparation for developing a new city, the students should be asked to examine the characteristics of the Valley relating them to ideal city features. In order to stimulate class discussion, the teacher will list the following features and ask the students to suggest their own ideal conditions and compare them with the existing Phoenix conditions. In doing this exercise, the students will be considering disadvantages and limitations in developing their new city.

The following suggestions will serve as a guide:

Water Source
- Ideal - river? spring? reservoir?
- Phoenix - wells, canals, S.R.P., C.A.P.

Climate
- Ideal - changing seasons? rain?
- Phoenix - hot and dry

Vegetation
- Ideal - forest, grassland
- Phoenix - barren desert

Wind
- Ideal - prevailing wind of moderate rate
- Phoenix - calm, temperature inversion pollution

Flood Control
- Ideal - well drained valley with channel to carry excess run-off.
- Phoenix - flat, subject to flash flood from normally dry washes

Location in Country
- Ideal - close to major market for products and recreation.
- Phoenix - fits

Transportation
- Ideal - easy access to other city with freeway going around city mass transit.
- Phoenix - poor mass transit, freeway cuts through city

Population
- Ideal - Zero Population Growth, self supporting
- Phoenix - one of fastest growing in U.S.

Materials: Same as preceding lesson.
Time Allotment: one class session
Supplementary Materials: None
Assignment - None

FIFTH LESSON

Aim: To have students begin designing their own city.

Approach: In this activity the students will start working in groups, and are asked to transfer the insights gained from the previous day's class discussion to their local setting. They will demonstrate their full ability to do this by the final development of the map of their new city.

Keeping in mind environmental considerations, each group is asked to formulate one or two general goals they wish to achieve in designing their city.

Examples:

To help all city dwellers to enjoy decent, meaningful, and independent lives in the cities of the future.

To help people realize that earth is an island, a spaceship and there is only so much land, water, and air.

To help people prepare emotionally, psychologically, technologically for the future.

The remainder of the class session will be spent developing group decisions on one or both of the following questions.

1. What conditions of life do you want to preserve and what do you want to eliminate?
2. What will be the effect of your city as a whole on man's social institutions, organizations, and individual behavior?

Materials: Players Manual

Time Allotment: One class session

Supplementary Materials: None

Assignment: None

SIXTH LESSON

Aim: To understand the concept of change.

To learn why people move and what they look for in a new environment.

To realize that there is a variety of dwelling types necessary to respond to the variety of man's needs.

Approach: This assignment is a continuation of the previous day's study and the purpose is to give the students a framework or base to work from, a deeper awareness of their city as it exists, what changes would be desirable to provide for future growth, and to understand the concept of change. This may take more than one class period.

Questions for Discussion:

1. Students are asked to discuss why change takes place in the city. Consider such things as: population density, street paving, high-rise apartments, freeways, shopping centers, blighted areas, urban sprawl.

2. Discuss how changes in a society lead to changes in the man-made environment, creating new forms and making others obsolete. The persistence of some forms, such as the church, Indian dwellings, can be used to illustrate that use of a building can remain somewhat constant and modifications can reduce the need for extensive change.

3. Discuss what changes are going on in the immediate environment.

4. Students can list things which have not changed and speculate why.

5. Students may discuss some of the reasons for living where they do. Have they moved recently? Why?

6. Discuss the limitations imposed by our society affecting our choices about where and what we build, how tall, how big, what style, how many families per acre, horse privileges, etc. (This discussion could include ideas about the economic and racial restrictions in our city.)

Discuss the idea of people being able to move based upon need and choice rather than upon restrictions and limitations of circumstance, in your city plan you will develop.

7. Students are asked to discuss changes that might occur to the environment between now and the next 50 years.

SIXTH LESSON (Cont'd)

8. Place the following chart on the chalkboard or have a student act as a recorder and keep a record of student responses to the following questions:

How many years has your family lived in Phoenix?
1 2 3 4 5 6 7 8 9 10 11 12 13

Why did your family come to Phoenix?
Health Climate Better job other

How long have you lived at your present address?
1 2 3 4 5 6 7 8 9 10 years

If you did not always live in your present home, why did you move there?
Closer to job
Closer to school
Better neighborhood
Good buy on house
Other

Materials: Same as preceding lesson.

Time Allotment: One to two class sessions.

Supplementary Materials: The Barrio Urban Planning Committee.
Advocacy Planning Document - Minority Opposition To Phoenix Comprehensive Plan 1990.

Assignment: Life Style Questionnaire (Optional)

Life Style Questionnaire

This problem investigates what different people in your city might look for in choosing a place to live. Think about what each one needs and put an X in the column under which you think they would prefer.

	What should be nearby														
	super market	factory	elementary school	junior high school	high school	movie theater	playground	swimming pool	drug store	department store	railroad station	bus stop or subway	fire station	police station	restaurant
Farmer with a wife and two children	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Junior High School student living with mother and **father, brother** and sister	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Factory worker and his wife	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Doctor, 70 years of age, alone and no longer practicing medicine	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
A mother with six children and her husband who is a fireman	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

	What kind of street				
	no cars allowed	many houses	few houses	quiet	busy
Farmer with a wife and two children	○	○	○	○	○
Junior High School student living with mother and **father, brother** and sister	○	○	○	○	○
Factory worker and his wife	○	○	○	○	○
Doctor, 70 years of age, alone and no longer practicing medicine	○	○	○	○	○
A mother with six children and her husband who is a fireman	○	○	○	○	○

	What kind of house									
	one bedroom	two bedroom	three bedrooms	four bedrooms	five bedrooms	row house	semi-detached	single detached	ground floor apartment	12th floor apartment
Farmer with a wife and two children	○	○	○	○	○	○	○	○	○	○
Junior High School student living with mother and **father, brother** and sister	○	○	○	○	○	○	○	○	○	○
Factory worker and his wife	○	○	○	○	○	○	○	○	○	○
Doctor, 70 years of age, alone and no longer practicing medicine	○	○	○	○	○	○	○	○	○	○
A mother with six children and her husband who is a fireman	○	○	○	○	○	○	○	○	○	○

	Where should it be					
	seashore	mountains	city	suburbs	center city	country
Farmer with a wife and two children	○	○	○	○	○	○
Junior High School student living with mother and **father, brother** and sister	○	○	○	○	○	○
Factory worker and his wife	○	○	○	○	○	○
Doctor, 70 years of age, alone and no longer practicing medicine	○	○	○	○	○	○
A mother with six children and her husband who is a fireman	○	○	○	○	○	○

SEVENTH LESSON

Aim: Study population make-up of Phoenix.

Approach: The following questions may be discussed in small groups or the class as a whole to better understand the population make-up of Phoenix.

1. Phoenix is one of the most rapidly growing American cities. What is the present population of Phoenix? How has the population of Phoenix changed over the past 10 or 20 years? What are projections for future growth?

2. Compare Phoenix population growth with selected cities over the past 10 or 20 years.

3. What do you suppose are some of the reasons for this fantastic growth rate? Support your answer.

4. The city has not only grown in numbers, but also in direction. In which direction has the city grown in the past? Why? Which areas of the city are the most densely populated now? The fastest growing now?

5. Demography

    a. Birth rates are an important index of population growth. The birth rate is figured on the number of live births per 100,000 population. How has the birth rate changed in Phoenix in the past 10 or 20 years?

    b. Larger families are often condemned as ecologically unsound. Minority groups are often said to have larger families. Is there any basis for these two statements? If so, what? Can you say that large families are the problem? Or is it the total number of children? If this is the case, is there any general conclusion to be reached?

c. Children yet to reach the child-bearing age can be a factor. Why is this so? What is the percentage of children under the age of 15 in the city of Phoenix? What are the socio-economic and ethnic percentages? Is this significant? Why?

The teacher will introduce Neighborhood Study Projects at the conclusion of class population discussion, as an assignment.

6. Neighborhood Study Projects

a. What do homeowners in the area think are the neighborhood's three biggest problems?

What might be done to solve these problems?

Conduct your study as a scientific random sampling to get an adequate cross-sample of ideas and opinions.

Survey 3-5 homes in the neighborhood attempting to get as much variety as possible.

b. Run a comparison of the city area and suburb area - size, amount of open space, number and kind of people, density, cultural and recreational activities, problems, etc. How do they differ; how are they similar? (Optional)

c. Conduct field trips to other similar areas of the Valley and note how they are similar and different. (Optional)

d. Conduct an extensive survey and mapping expedition of a two square mile radius around the school. Map the area block by block. Use symbols and drawings to designate different types of land usage.

7. Zoning

a. Determine major land usages within the community by percentages and major concentrations within the city and the study area -
   1) residential
   2) commercial
   3) industrial
   4) public lands
   5) semi-public lands

b. Conduct a survey as a City Planning Committee to determine the various types of housing available.

c. Investigate city ordinances - zoning, building, subdivisions, health. What are the purposes behind each? How were they arrived at? Which ones need to be changed? Does the method of arriving at them need to be changed? Prepare alternative ordinances to the ones that you think are weak and work out a plan to put these changes into effect.

d. Appoint study groups to examine small land areas (3-4 blocks) with which the group is familiar and plan for and develop a plan for future land use in the area.

1) sketch the area with all existing buildings and land use.

2) consider future land use that will be compatible with present land use.

3) sketch future land use proposals and justify your actions to a mock city council and homeowners in the area.

Materials: Arizona Statistical Review, 1970 Valley National Bank, Inside Phoenix, 1971 - Economy, Phoenix Newspapers, Inc.

Time Allotment: One class session

Supplementary Materials: A Phoenix Road Map (For use in 6d.)

Assignment: Neighborhood Study Project

EIGHTH LESSON

Aim: To develop land use for the model city.

Approach: The teacher will ask each group to review information in the data bank. (approximately 5-10 minutes)

Refer to the Data Bank and the Materials section on Page 4 of this guide to supply the statistical information needed in this lesson.

The teacher should ask the class to keep in mind the limitations of the project, such as current population, income level of different groups, and that students' plans should consider a labor force of 378,000 for 1990. These people will require a certain amount of land in various categories of use.

Each group will develop a list of services, organizations, facilities, and land use that they wish to plan and provide for in their model city. Toward the end of the period the teacher should write the following list on the board as a comparison. (The students may or may not want to include all in their plans.)

schools
police
hospitals
fire houses
streets and alleys
flood prevention
agriculture areas
mobile home concentrations
freeways
post office
factories
banks
truck docks
railroads
subway
bus routes
office space
libraries

parks
recreation areas
footpaths
bicycle paths
single-family units
multi-family units
commercial areas
industrial areas
landfill operations
airports
water and sewer system
sanitation
street maintenance
canals
trees - landscaping
fire hydrants
vehicle parking
green belt - open space

Materials: Data Bank

Time Allotment: One class session

Supplementary Materials: None

Assignment: Using the list of features the groups compiled in class, the students are to rate their own neighborhood as to the availability of the feature. If they are within 2 miles of their home they are to place a check after that feature. (Optional)

NINTH LESSON

Aim: To develop the model city.

Approach: This is the principal part of the simulation and should last for 5-10 days, or however long the groups take to successfully complete the activity. It can be adapted to the teacher's lesson plans, or interest generated by the students.

During the remainder or this part of the simulation the students will work in groups to construct the city as they visualize it, using information they have worked out in the group discussions.

By mapping and considering land uses, it is possible to plan intelligently for city development. This methodology is indispensable in city-planning as it reveals city problems and the potentials for correcting them. By the application of generalizations to the city he knows, the student begins to see that some sort of order does exist is a city.

Students will construct a land use map using materials furnished in class and their list developed in Lesson 7.

There are several ways to construct this map. For example, the city areas can be filled in with patterns or colors that indicate how they are used, which can be interpreted from the legend. Only the dominant land use should be shown for each area.

Students should indicate what the different colors on their maps stand for. They should realize that when they color an area they are identifying only the major land use (residential, industrial, or other) because the scale of the map does not permit them to show details.

A color key can be developed to show each category of land use. This could make the comparison of the group's map much simpler at the end of the project. A typcial one is as follows:

Manufacturing - Red
Commercial - Light Red
Public buildings - Yellow
  (church, school, university, hospitals)
Parks, cemeteries - Dark Green
Residential:
    single-family -- Purple
    multi-family -- Orange
Landfill - Black dots
Transportation System - Black
Agricultural - Light Green
Unused - Brown
Water - Canals, rivers, lakes -- Blue

The finished map developed by the students may show:

Limits of urban settlement
Downtown commercial core
Important shopping centers
Major Industrial sections
Major transportation arteries and facilities
Major areas of public land uses (buildings, parks, university)

At the conclusion of this activity, the students should realize that the solution to our environmental crises involves individual action and a cooperative effort between the people and their government.

They should be able to explain the different kinds of land use and why they located it where they did.

They should be able to explain why a city grows or declines.

They should be able to infer that man is part of an eco-system that has a delicate balance and that preservation and improvement of our environment may involve a commitment to a change of attitudes and life styles.

Materials: Phoenix Comprehensive Plan 1990
Colored pencils or map marking crayons.
Large sheets of white paper. (newsprint, butcher paper, etc.)

Time Allotment: Five to ten class sessions.

Supplementary Materials: None

Assignment: Continue work on model city development.

ENRICHMENT ACTIVITIES

Prior to actual development of model city in Lesson 9, the teacher may decide on an in-depth study or a more concentrated development of the simulation, the authors suggest a day by day planned approach of this phase of the program, so that study, research and discussions will accompany the actual considerations of land use. This will enhance the student involvement and guarantee that environmental considerations will take place.

An example of this would be to consider the planning of their city in successive parts, progressing to the next only when the previous one has been fully developed. Suggested parts are:

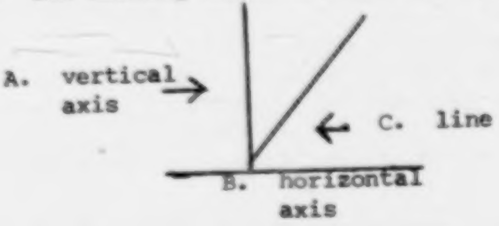
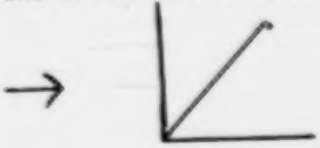
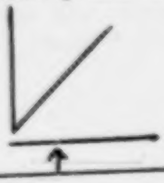
1. Physical Environment - Three (3) Projects
2. Education
3. Housing and Zoning
4. Utilities
5. Industry
6. Transportation
7. City Government
8. Health Problems

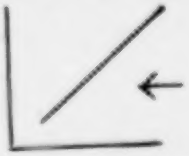
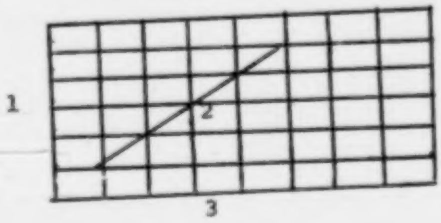
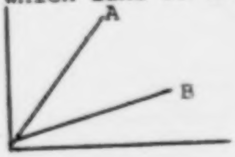
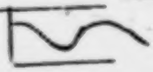
ENRICHMENT UNIT I - PHOENIX CLIMATE

Many times when data is collected it is pictured on a graph. By the use of graphs, it is easy to see how one factor is related to another. This exercise is designed to help you make and read one type of graph, the line graph.

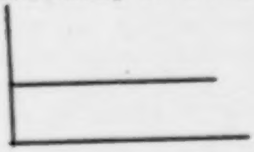
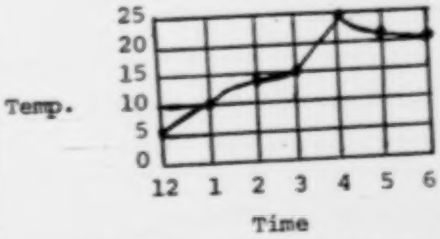
HOW TO USE THIS PROGRAM

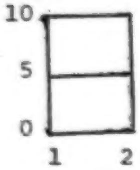
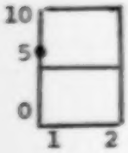
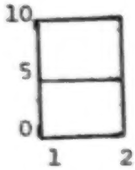
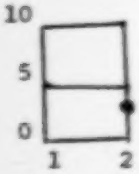
You will learn a great deal from this program if you use it properly. Cover all of the page with a sheet of paper. Then pull down the sheet of paper until you come to the first "frame" (information and blank spaces for you to write in.) Look at the first frame; carefully study the information. Try to answer the question by filling in the blanks. Then pull down the sheet of paper until you can see the correct answer (to the left.) Of course it is easy to simply look at the correct answers and copy them but you would not learn very much. In a program you learn from answering questions, not from copying answers. A program is not a test! There is no penalty for wrong answers. If you do get an answer that doesn't agree with the program, go back to the previous frame and find out where you went wrong.

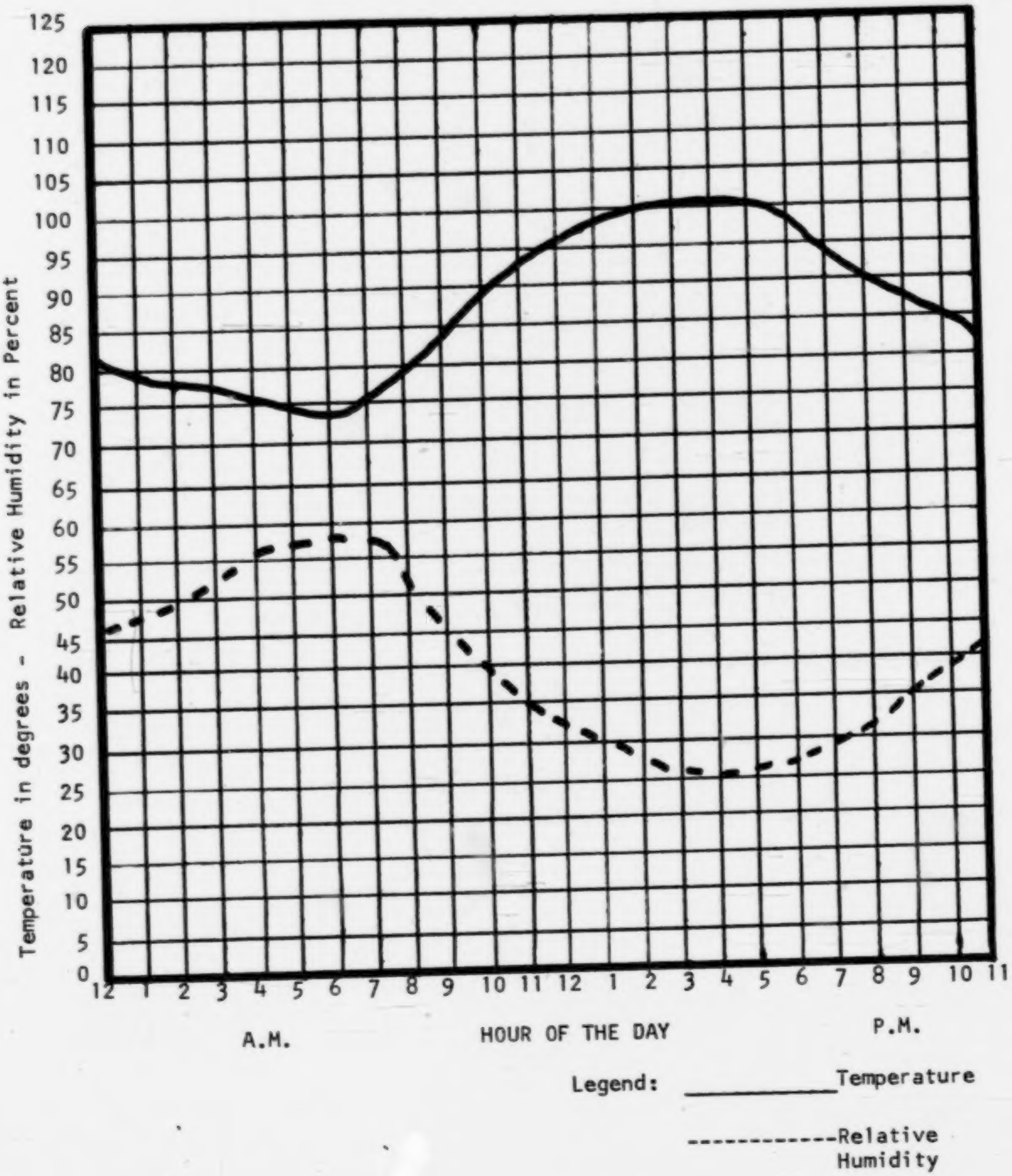
	1. The drawing below shows a line graph.  A line graph has three basic parts. They are A.________________ B.______________ __________ C. ______________
A. vertical axis B. horizontal axis C. line	2. The arrow in this drawing points to the ______________ axis. 
vertical	3. In this drawing the arrow points to the ______________. 
horizontal axis	4. The __________________ axis runs from the bottom to the top of the graph.

vertical	5. The arrow in this drawing points to the ________________. 
line	6. Label the parts of a line graph  1. ________________ 2. ________________ 3. ________________
1. vertical axis 2. line 3. horizontal axis	7. When one constructs a graph, one places a dot at the intersection of the correct vertical and horizontal line. In order to show increase of a quantity, you place the dot higher on the graph. If you want to show a ______________of a quantity you place the dot higher on the graph.
decrease	8. The lines on either the vertical or horizontal axis should be evenly spaced with the same value between each line. If a vertical axis began 0, 2, 4, 6, the next line should be marked __________.
8	9. If the horizontal axis begins 0, 5, 10, 15, 20, the next number would be _________.
25	10. If you connect the dots on your graph, the line will go up, down, or stay at the same level. If the line goes up, it shows an increase; and if it goes down, there is a ________. If there is no change, the line would __________ _________ __________.
decrease stay the same	11. If one were reading a graph and saw two lines, as in the figure below, which line is showing the fastest increase? ___. 
A	12. In the following graph, the line shows first a __________ then a ______________ followed by a ________________. 

Making a Graph

decrease increase decrease	13. Is the following line showing an increase, decrease or no change?  Ans.________________
no change	14. The amount of material to be presented on a graph will determine what value is given to each line. In order to make the graph easy to read, the entire space available should be used if possible. The graduations (spaces between the lines) can be any convenient value. If you had the numbers 2 8 14 and 18 to put on a graph that had to be placed vertically on a graph with 25 lines, what value would you give each line? ____________________
1	15. If you had 20 lines and you had to show the numbers 15 30 45 60 and 85, what value would you give each line? _________
5	16. Unless unusual data is to be presented, both the horizontal and vertical axis should start at the complete absence of any of the quantity to be shown. What value would you give the very bottom line? ____________________
0	17. What number would you give the line to the extreme left? ___
0	18. Observe the graph below:  What was the temperature at 12 o'clock? __________
5 degrees	19. Between 12:00 and 1:00 did the temperature rise or fall? ___________
rise	20. How much did it change? _________________
5 degrees	21. Often due to lack of enough lines on the vertical axis, each line represents more than one unit. How many degrees does each horizontal line represent?

5 degrees	22. If the number you are trying to show on a graph is not shown on the vertical axis, you must place the dot between two lines. You should imagine that there are smaller invisible horizontal lines between the two shown. For example, where would you place a dot to show the number 6 on line 1? 
	23. To show the number 3 on line 2 - where would the dot be placed? 
	24. Concerning the graph in frame 18, what was the temperature at 5 o'clock?
22 degrees	25. Between which two hours did the temperature rise the most? ____________________AND__________________.
3 and 4	26. At what hour was it the hottest? ________________
4 o'clock	27. When was the coldest temperature recorded? __________
12 o'clock	28. An hourly record was kept of the average temperature and relative humidity for the month of August in Phoenix. The data is on chart on following page (39).


Temperature in degrees - Relative Humidity in Percent
125
120
115
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11
A.M.
HOUR OF THE DAY
P.M.
Legend:
Temperature
Relative Humidity

28. cont'd.

Hour AM	T	RH	Hour PM	T	RH
12	81	46	12	96	33
1	79	48	1	98	30
2	78	50	2	100	28
3	77	53	3	101	26
4	76	56	4	101	25
5	75	57	5	100	26
6	74	58	6	98	27
7	76	56	7	95	29
8	79	50	8	91	32
9	85	45	9	88	35
10	90	40	10	86	39
11	94	37	11	83	44

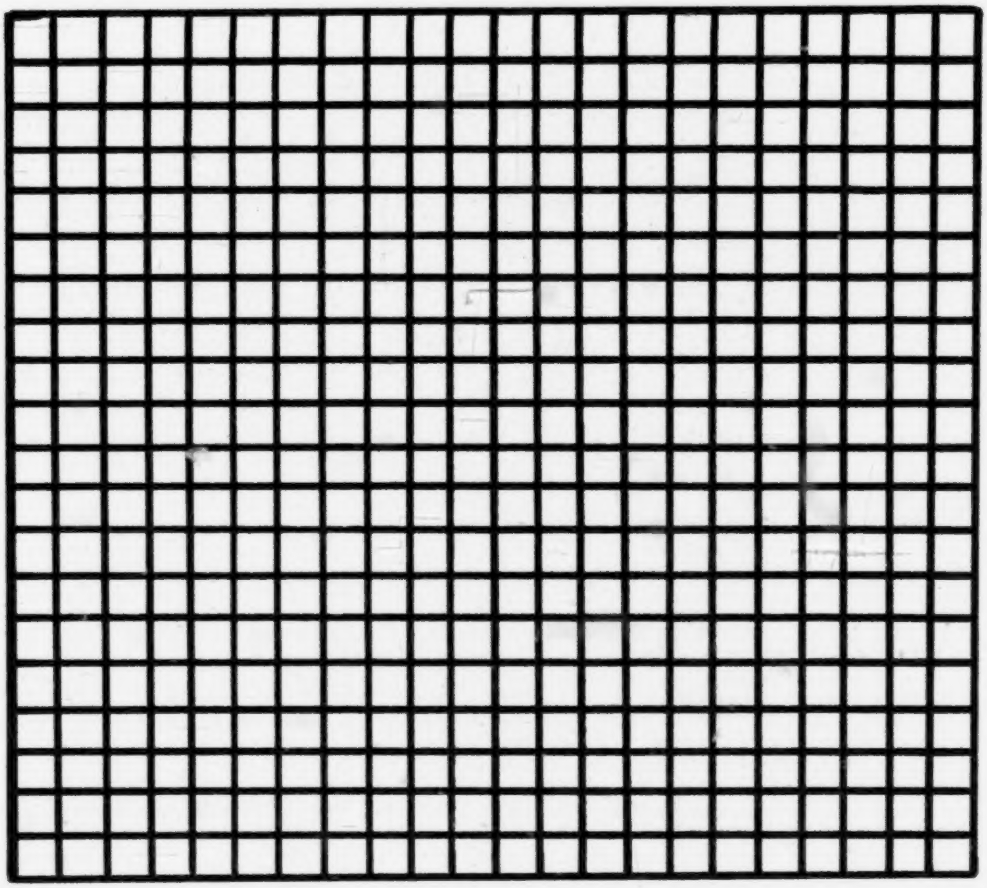
	29. At what hour is it the coldest? a.)________________ When is the humidity the lowest? b.)________________
a. 6 A.M. b. 4 P.M.	30. The range of temperature was from a low of a.)______ to a high of b.)________.
a. 74 b. 101	31. The range of relative humidity is from a low of a.)____ to a high of b.)_____.
a. 25 b. 58	32. At 7:00 P.M. the temperature was ____________.
95	33. At 11:00 A.M., the relative humidity was ____________.
37	34. At 4:00 P.M., the relative humidity was _____________.

25	35. Sometimes more than one line is shown on a graph. In order to show the meaning of each line a "legend" is included. The legend in frame 34 tells you that the two different lines show ____________ and ____________.
Temperature Relative humidity	36. The hour of the day is shown on the ____________ axis.
Horizontal	37. The temperature and humidity rate is shown on the ________ . axis.
Vertical	38. The dotted line represents the ________________.
Relative humidity	39. The temperature is represented by the ____________ line.
Solid	40. At what time was the temperature the highest? __________.
3 or 4 o'clock	41. When was the day the coldest? ______________.
6 a.m.	42. At what time was it the most humid? (highest relative humidity) __________.
6 a.m.	43. When was the air the driest? ____________.
4 p.m.	44. At 12 a.m. the temperature was ________ degrees and the relative humidity was ________ percent.
81, 46	45. According to the graph was the temperature rising or falling between 12 a.m. and 4 a.m.? __________
falling	46. What was the humidity doing during this same time period? ______________
rising	47. In the evening does the temperature rise or fall? ________
fall	48. During the same time period did the humidity rise or fall? ____
rise	49. Based on this graph, one can say that as the temperature increases, the humidity ______________.

decreases	50. It should also be noted that as the temperature falls, the humidity ______________________________.
rises	51. Using what you know about constructing graphs, place the following information on the blank graph concerning "Percent of sunny days per month in Phoenix."

MONTH	AVG. % OF SUNSHINE
January	77
February	80
March	83
April	88
May	93
June	94
July	84
August	85
September	89
October	88
November	84
December	77

TITLE ______________________________



THE MEANING AND DEVELOPMENT OF TEMPERATURE INVERSION

Introduction: "Come to Sunny Phoenix." This statement advertises our usually fine clear air. Most of the time our visibility is almost unlimited but sometimes one tends to think they have taken the wrong turn and ended up in Los Angeles. Our weatherman blames these "smoggy" days on a phenomenon called a "temperature inversion". The purpose of this exercise is to study how and why this situation occurs.

Background: Under normal atmospheric conditions, the temperature of the lower air drops steadily with increasing height above the earth's surface. In other words, as air rises, it cools. This drop in temperature is known as the normal lapse rate. It is about 3.5 degrees F. per 1,000 feet. From time to time however, we find sections of the atmosphere in which the temperature rises for a time, as altitude increases. This means that the air is warmer rather than colder as we go up in it. Since air temperatures are literally "upside down" we call this a temperature inversion.

In this exercise we shall trace the development of two cases of temperature inversion. In the first case, the lower air cools by contact with the cold ground on a calm night. In the second case, the cause of cooling is the same, but moderately strong winds near the surface mix the cool surface air with warmer air above, and raise the inversion layer to some distance above the ground.

Materials:
Accompanying graphs
ruler
colored pencils (3 colors)

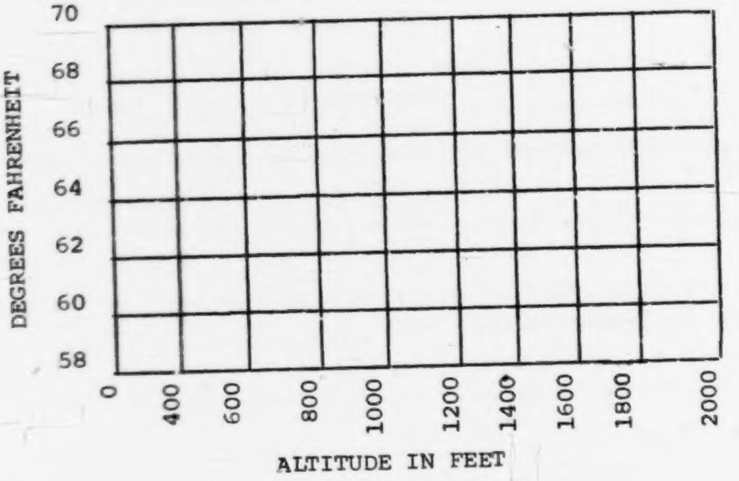
Directions:

1. Plot the data from Table A onto Graph A. Use a different colored pencil for each time reading. (Be sure to indicate which color is which of the legend.) Connect the successive points with straight lines. Then answer the accompanying questions.

2. Repeat the same process for Graph B and answer the Section B questions.

Demonstration Kit - create a temperature inversion air
pollution instructional module.

GRAPH A: INVERSION DEVELOPMENT ON A CALM NIGHT



Legend:
6PM color ________

Midnight
color ________

6AM color ________

TEMPERATURE

Altitude	6PM	Midnight	6AM
0	70	62	58
100		69	
200			68
400			
500			
800			
1000	66	66	66
2000	62	62	62

TABLE A

SECTION A QUESTIONS:

1. The 6 p.m. graph line shows a normal situation with respect to temperature. State what this relation is in a few words. ______________
____
____.

2. What rate of temperature change is shown on the 6 p.m. line on the graph? ____________degrees per__________feet.

3. How does this rate compare with the "normal lapse rate" described in "Background"? ______________________________
____
____.

4. Concerning the midnight line describe what temperature changes take place as one increases in altitude. ______________________
____
____.

5. Why did this happen? ______________________________
____
____.

6. Describe the further changes shown by the 6 a.m. line.____________
____
____.

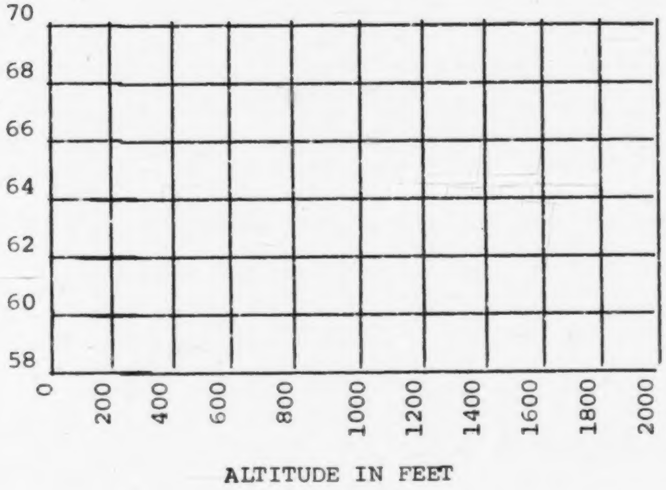
7. Why is the cooling shown in the graph confined to the lowest layer of the atmosphere? ______________________________
____
____.

8. Explain what a temperature inversion is. ____________________
____
____.

9. Between which levels does the 6 a.m. inversion lie? ______________and ______________________feet.

10. What will probably happen to the temperature inversion after 6 a.m.?
____.
Why? ____
____
____.

GRAPH B: INVERSION DEVELOPMENT ON A WINDY NIGHT



Legend:
6pm color _______

Midnight
color _________

6am color _______

TEMPERATURE

Altitude	6 PM	Midnight	6 AM
0	70	64	61
100			
200			
400		62	
500		68	
800			
1000	66	66	60
2000	62	62	62

TABLE B

SECTION B QUESTIONS:

11. State the rate of temperature change shown on the 6 PM line. ______

____.

12. Describe the changes in air temperatures shown by the midnight line.

____.

13. In what important respect are these different from the midnight line on Graph A? ____

____

____.

Why? ____.

14. Describe the further changes shown on the 6AM line. ____________

____

____.

15. Compare the lapse rate (rate of temperature change) in the inversion layer with that of the normal layer above it. ______________

____

____.

16. Between what levels does the 6 AM inversion layer lie? __________

____.

INVERSION AND CONDENSATION

When air is cooler below its dew point, its water vapor condenses, and fog or cloud forms.

17. If the dew point of the lower air in A is assumed to be 62 degrees F., at which levels will fog develop by 6 AM? ________________

____.

18. If the dew point of the air in B is below 1,200 feet is assumed to be 60 degrees F., at which levels will clouds develop by 6 AM? ______

____.

ENRICHMENT UNIT 2 - Water For The Valley

The purpose of this exercise is to aquaint you with the concept of the local water budget. Learning how to organize certain data given will enable you to account for moisture income, storage and outgo at a particular area. In order to accomplish this goal we will first use as an example data concerning Houston, Texas and then follow the inentical steps to learn about our own Phoenix area.

There are three steps in each part of this exercise. They are A) filling in the data table on the attached sheets, B) constructing a graph to visualize the data from the table, and C) interpret the graph by answering a series of questions concerning the graph.

Part I

A. Directions for filling in the top table -

Definition of symbols -

P - precipitation (rain, snow, sleet, hail)

PE - Potential evapotranspiration, this is the amount of moisture that will evaporate from surfaces combined with the moisture given off by plants.

P-PE - difference between P and PE is larger then the result will be a - number

AST - change in the soil moisture storage since the previous month. If water is added this will be a number, if water is withdrawn this will be a number.

ST - soil moisture storage at the end of the month. This cannot be more than 100 or less than 0.

AE - actural evapotranspiration

D - water deficit

S - water surplus

To start the Calculations:

1. Remember numbers are in mm moisture. (There are 25.4 millimeters in one inch.) Scientists use 100mm. as the average storage capacity but could vary depending on soil porosity and other factors.
2. Place the P (percipitation) and PE (potential evaporation) numbers in the proper boxes. (This has already been done for you in the example tables.)

3. Subtract the PE number from the P number and place this difference in the P-PE box. If the P number is smaller than the PE subtract it and indicate the difference by putting a - in front of the number.

4. Add up all the positive P-PE numbers.

   A. If the number is 100 or greater - Put 100 in the ST box for the month before the first negative P-PE value.

   B. If the number is less than 100 - Put whatever that number is in the ST box for the month before the first

5. Start calculations with the first month that shows a negative (-) P-PE number. Example - Since there is 100mm of stored in April when you subtract the -6 for May you now have -6 in the ΔSt box indicating change and only 94 left in the storage (ST). In June you subtract -50 the change)(ΔSt) -50 and now your storage has dropped to 44 (ST). In July when you see the -84 to be subtracted, realize that there is only 44 left stored so that if all the change possible for the ΔST number and the storage (ST) is now 0. Continue the same steps for the other months.

Important to Remember

A. The most you can store (ST) is 100 and least there can be is 0

B. Withdraw from storage (ST) means Δ ST is -

C. Deposit to storage means ΔST is +

6. You are now ready to compute the AE or actual evapotranspiration. This number will be equal to the potential in any month where the P number is larger than the PE. In other words, if there is enough rain to evaporate that much moisture. In any month when there is not enough rain PP to evaporate the PE amount, all the rain that falls will evaporate plus any that is stored in the ground (ST). (If none is stored then only the P amount will be evaporated.)

7. The deficit (D) number is the shortage in the soil. This number would 0 anytime the P is larger than the PE. If the PE is larger that the P number the deficit (D) will be the difference between the two.

8. To obtain the S (surplus) it is necessary to look at the amount stored (ST). Anytime 100 is stored then the surplus would be the difference between the P-PE (left over rain). When the storage (ST) is) there can be no surplus (S) until the full 100 is stored. Anything left over after

B. Directions for completing the graph:

1. Place P numbers on the graph putting a dot in the center of each month's column. Connect the dots with a colored pencil. Make the January and December lines go up or down whatever the case may be to show that they would be continuous.
2. Repeat the procedure for the PE numbers only connect these dots with a different colored pencil.
3. Label each line at its beginning and end with is letter so you can remember what each line stands for.
4. The recharge markings should be used whenever the P line is higher than the PE until such time that a surplus occurs.
5. The usage markings are to be used whenever the PE line is above the P line until such time that a deficit occurs. In the middle of the deficit month begin using deficit markings.

C. Interpretation:

After completing the graph for the Houston area, answer the following questions.

1. How well does the precipitation pattern match the PE curve through the year?
2. Why is PE so low in January and so high in July?
3. During what months does a water surplus occur? Mark this on your graph.
4. How do you know when to end the water surplus period? What causes the surplus period?
5. When did a period of water deficit begin? Mark this on your graph.
6. During what months is stored moisture drawn from the soil by plants and evaporation?
7. During what months would you say that irrigation is most likely to be needed?

WATER BUDGET

FOR Houston, Texas

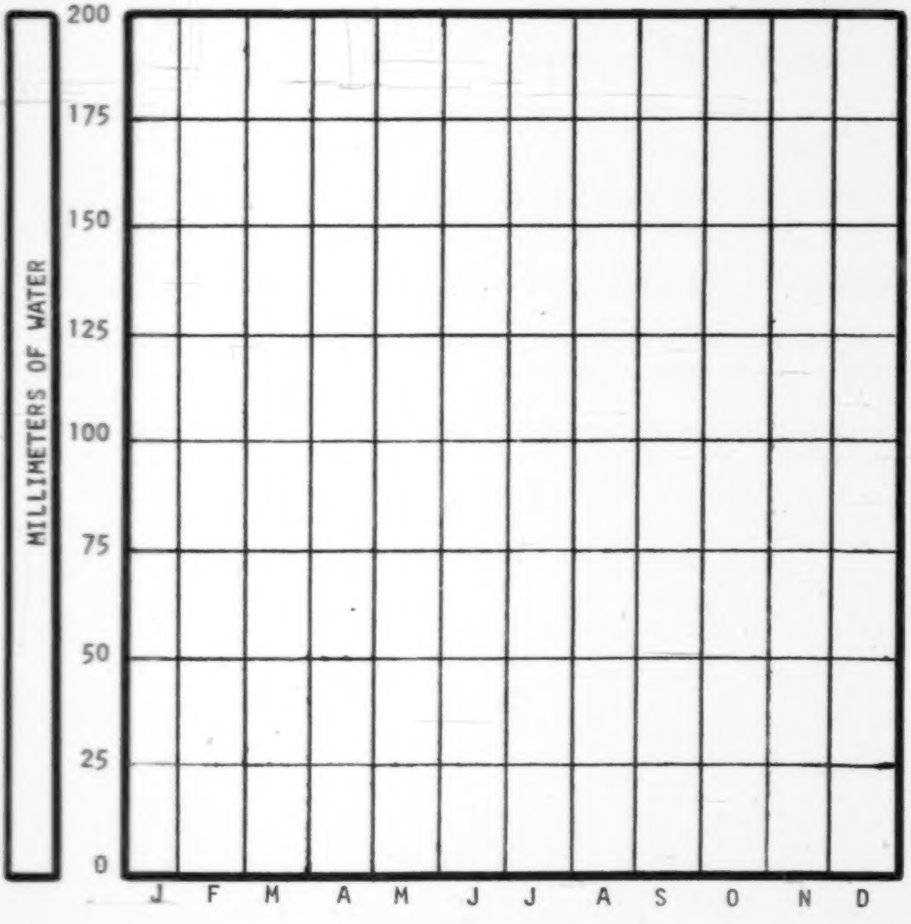
	J	F	M	A	M	J	J	A	S	O	N	D
P	89	75	85	92	119	116	98	99	103	95	89	108
PE	19	23	50	83	125	166	182	172	135	81	39	20
P-PE					-6	-50						
Δ ST					-6	-50						
ST				100	94	44						
AE					125	166						
D					0	0						
S					0	0						

▥ SURPLUS

▒ DEFICIT

▩ USAGE

▧ RECHARGE



Part II

After completing the information for Houston, Texas, use the data on the attached pages and fill in the top table and construct a graph for the Phoenix, Arizona, area. If time permits, you may want to study some other part of the country. Compare all of your graphs and interpret your findings using the list of questions as a guide.

SUMMARY

Water on the land can be considered in terms of income, storage, and outgo. Precipitation is the important source of income. Its distribution on the earth varies widely and depends on the season and geographic location.

Water reaching the land through precipitation may infiltrate, run off, or evaporate and transpire. Water may be stored on the land in snowfields, ice caps, lakes, and streams. Or water may be stored in the soil as capillary water in the root zone or as gravity water at low levels. Water is removed from the land largely by evapotranspiration. Two-thirds of the precipitation falling on the continents as run off in surface streams and ground water.

The local water budget is a convenient model to account for income, storage, and outgo at a particular place. By the means a value for deficit or surplus may be derived for each month. In adjusting to his environment and altering it for his convenience, man sometimes finds it necessary to change the patterns of water on the land.

In a dry region such as southern Arizona precipitation may be consistently less then PE. Types of plants completely foreign to humid regions are found. Generally, desert plants are widely spaced so that they do not have to share the limited water with so many competitors. Desert plants have evolved many modifications that allow them to adapt to a dry environment. Some are able to control the amount of water transpired by closing the pores in their thick-walled leaves. Many desert plants have the ability to store water for use during periods when there is little moisture.

It is possible to grow crops in a desert simply by importing water from an area of surplus. In this way the water shortage is overcome and the desert land takes on some characteristics of humid land. However, if the southwestern United States as a whole is a deficit region, where are the surplus areas from which to import water? Look at a physical map of the area. Notice the mountain ranges. For years these have been the major source areas for surplus water in the west. This is why mountain watersheds are so important to the livelihood of the region. The Salt River Project has been responsible for importing water to the valley from its mountains drains by way of a system of canals. However, if the Valley continues to grow at its present rate, additional water is essential. It is because of this need that the Central Arizona Project was conceived.

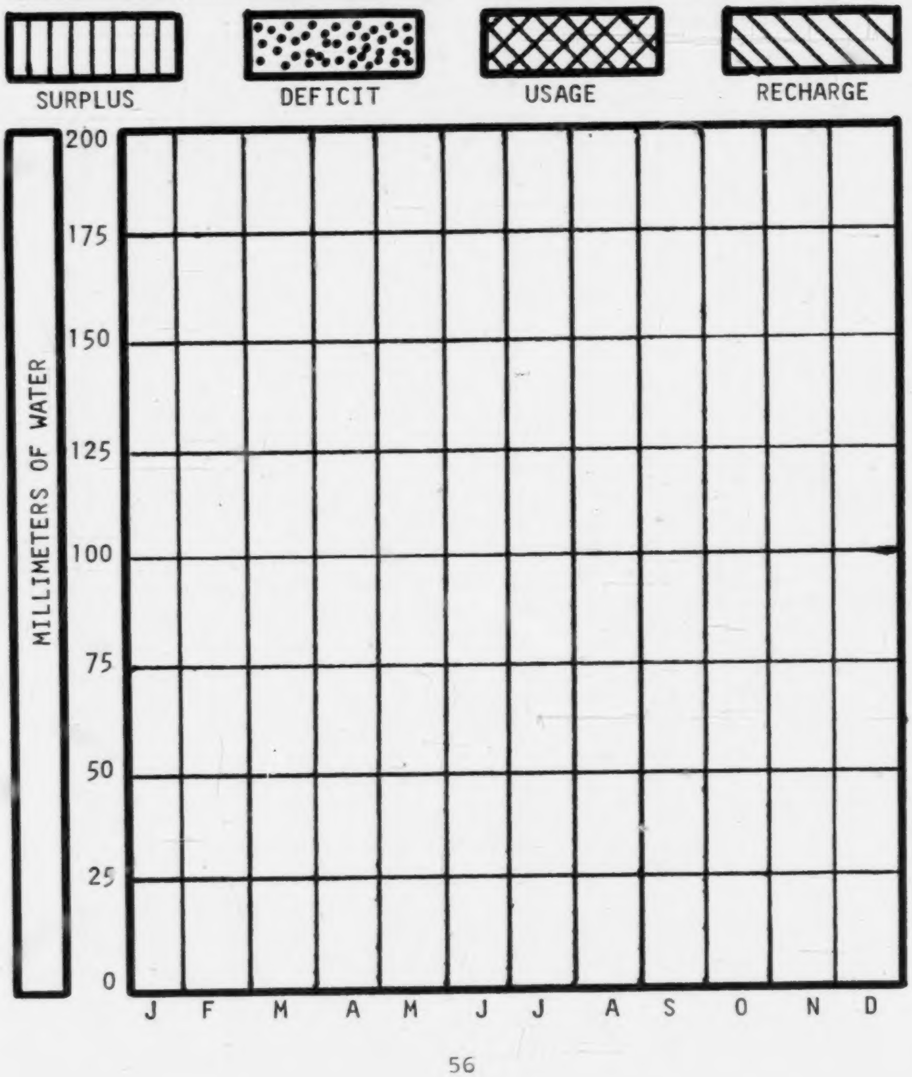
United States		J	F	M	A	M	J	J	A	S	O	N	D	Yr
Alexandria,	PE	15	18	45	75	122	164	179	170	129	69	31	15	1032
Louisiana	P	127	133	142	134	119	115	136	106	73	85	111	152	1433
New Orleans,	PE	22	26	49	84	127	168	180	171	139	88	40	24	1118
Louisiana	P	115	117	139	135	124	147	177	153	140	85	92	119	1543
Bangor,	PE	0	0	0	37	84	120	145	127	81	45	12	0	651
Maine	P	81	67	73	88	79	82	67	67	92	85	104	79	964
Portland,	PE	0	0	0	30	69	108	133	115	78	43	17	0	593
Maine	P	101	105	101	88	87	82	80	77	82	82	96	96	1077
Baltimore,	PE	0	3	19	50	96	134	163	142	59	55	20	5	746
Maryland	P	86	81	95	90	93	97	113	114	90	77	72	80	1088
Cumberland,	PE	0	1	13	48	93	128	145	126	89	48	15	2	708
Maryland	P	62	64	75	72	84	102	82	88	69	61	54	64	877
Boston,	PE	0	0	9	37	79	118	142	125	87	51	20	0	668
Massachusetts	P	93	84	98	91	83	81	84	94	81	84	97	88	1058
Pittsfield,	PE	0	0	0	29	77	109	128	112	75	30	9	0	579
Massachusetts	P	79	64	81	91	97	117	127	109	107	74	101	76	1123
Lansing,	PE	0	0	0	34	76	119	135	122	81	46	10	0	623
Michigan	P	46	44	62	71	92	84	70	73	73	65	57	48	786
Sault Ste. Marie,	PE	0	0	0	20	66	101	123	110	75	37	0	0	532
Michigan	P	50	36	44	55	69	75	68	72	91	75	77	57	769
Duluth,	PE	0	0	0	24	66	98	127	113	75	37	0	0	540
Minnesota	P	27	25	39	54	79	103	95	84	80	53	41	27	707
Minneapolis-	PE	0	0	0	37	88	124	149	127	81	39	0	0	645
St. Paul, Minn.	P	20	22	37	52	85	107	89	83	74	49	34	23	675
Jackson,	PE	16	21	40	71	118	159	178	166	124	71	29	15	1008
Mississippi	P	124	124	140	132	112	104	114	88	64	54	91	135	1282
Tupelo,	PE	9	12	34	64	108	152	168	158	115	60	24	10	914
Mississippi	P	114	108	153	116	120	98	98	99	81	65	98	134	1284
Kansas City,	PE	0	0	15	53	96	141	170	152	100	55	15	0	797
Missouri	P	35	39	65	85	94	95	94	100	103	72	47	36	865
St. Louis,	PE	0	0	19	53	100	145	170	152	100	55	18	2	814
Missouri	P	57	60	83	94	105	106	83	76	80	69	67	54	934
Great Falls,	PE	0	0	0	34	74	103	140	121	76	42	7	0	597
Montana	P	17	20	23	26	60	76	22	27	32	19	21	14	368
Miles City,	PE	0	0	0	34	81	113	154	135	78	39	0	0	634
Montana	P	10	10	15	27	50	80	36	33	27	23	11	8	330
Missoula	PE	0	0	9	41	74	103	136	117	72	33	2	0	587
Montana	P	25	22	22	26	47	51	24	21	31	27	28	28	352
Lincoln,	PE	0	0	0	47	90	136	164	143	94	49	10	0	742
Nebraska	P	19	25	36	63	97	110	92	88	74	46	30	21	701
Scottsbluff,	PE	0	0	9	40	79	118	146	129	81	40	7	0	649
Nebraska	P	9	12	22	47	70	70	45	34	34	23	12	12	390
Las Vegas,	PE	5	10	31	69	123	183	208	195	139	67	21	76	1127
Nevada	P	14	9	11	6	2	1	13	12	9	7	8	10	102
Reno,	PE	0	7	22	40	71	101	130	117	78	43	17	2	628
Nevada	P	35	28	20	12	15	9	7	6	7	11	16	27	193
Hanover,	PE	0	0	0	30	77	112	134	113	76	39	6	0	587
New Hampshire	P	69	58	66	66	79	86	89	89	81	79	71	66	899
Manchester,	PE	0	0	0	31	81	118	135	120	79	41	12	0	617
New Hampshire	P	84	76	91	81	79	81	86	86	86	76	84	81	991
New Brunswick,	PE	0	0	12	42	86	123	145	126	90	50	18	1	693
New Jersey	P	93	91	92	94	98	96	129	131	92	91	85	91	1183
Vineland,	PE	0	1	14	43	90	128	154	133	93	51	18	2	727
New Jersey	P	100	93	99	86	91	89	118	120	91	82	79	96	1144
Albuquerque,	PE	3	8	25	52	91	134	151	136	95	52	15	3	766
New Mexico	P	9	9	10	15	17	15	36	33	23	21	11	11	210
Carlsbad,	PE	11	15	38	66	112	155	169	156	109	61	25	8	925
New Mexico	P	8	9	14	20	19	45	61	48	43	36	14	14	331
Buffalo,	PE	0	0	0	30	72	111	135	122	84	48	15	0	617
New York	P	81	72	71	68	73	69	73	74	75	78	80	81	895

United States		J	F	M	A	M	J	J	A	S	O	N	D	Yr
Phoenix,	PE	13	21	40	75	129	189	211	193	158	84	31	13	1157
Arizona	P	21	19	17	10	3	2	25	27	19	12	15	21	191
Tucson,	PE	16	21	37	65	114	170	192	176	142	79	32	16	1060
Arizona	P	21	22	19	10	5	7	56	55	29	14	20	25	283
Fort Smith,	PE	5	8	31	62	109	152	181	167	117	64	23	8	927
Arkansas	P	61	68	36	43	223	45	264	41	42	45	15	143	1026
Little Rock,	PE	8	10	31	65	112	151	176	160	114	64	23	10	924
Arkansas	P	125	102	118	128	127	94	85	84	80	72	104	104	1223
Fresno,	PE	13	20	37	63	99	139	180	165	114	70	31	12	943
California	P	44	40	41	24	10	3	0	0	4	13	22	40	241
Los Angeles,	PE	34	36	49	59	76	94	117	115	96	73	52	39	840
California	P	78	79	66	27	9	2	0	1	5	14	29	68	378
San Francisco,	PE	31	35	49	59	70	78	79	77	75	66	48	35	702
California	P	119	93	77	39	17	4	0	1	7	24	59	111	551
Denver,	PE	0	0	12	37	74	112	141	127	81	43	12	2	641
Colorado	P	12	14	28	52	62	36	42	36	26	26	16	16	366
Grand Junction,	PE	0	0	19	47	89	134	163	138	94	46	10	0	740
Colorado	P	15	16	20	19	18	10	15	28	23	22	15	14	215
Hartford,	PE	0	0	9	37	83	118	142	125	84	46	15	0	659
Connecticut	P	91	81	94	94	89	89	95	102	89	78	94	91	1087
New London,	PE	0	0	9	37	79	113	136	123	87	51	19	1	655
Connecticut	P	99	95	102	93	86	79	91	107	84	91	98	92	1119
Milford,	PE	3	3	22	48	92	129	154	137	99	55	25	6	773
Delaware	P	91	89	100	91	91	94	114	115	85	81	75	93	1119
Wilmington,	PE	0	0	15	43	89	128	152	135	94	52	20	2	730
Delaware	P	87	80	96	91	92	98	119	128	93	78	82	86	1130
Miami,	PE	47	50	74	103	136	162	172	168	147	116	76	57	1308
Florida	P	49	43	54	109	155	194	202	182	125	206	73	45	1547
Orlando,	PE	33	39	59	90	140	167	175	173	142	100	53	35	1206
Florida	P	50	56	91	88	81	161	230	180	200	121	39	45	1342
Albany,	PE	15	19	45	76	124	165	177	166	129	73	26	17	1032
Georgia	P	108	131	125	95	96	115	155	142	88	61	60	99	1275
Atlanta,	PE	11	13	31	62	108	144	157	146	111	61	26	10	880
Georgia	P	120	119	139	101	88	96	119	103	82	64	77	112	1221
Honolulu,	PE	68	65	77	87	105	118	119	120	118	108	86	76	1167
Hawaii	P	87	102	81	53	35	21	26	31	37	45	86	99	703
Boise,	PE	0	5	2k	47	80	112	152	133	81	46	12	0	689
Idaho	P	37	35	34	30	33	23	6	5	12	26	33	34	308
Pocatello,	PE	0	0	12	40	72	107	142	125	87	40	10	0	635
Idaho	P	32	27	31	33	34	26	17	18	21	26	24	27	316
Chicago,	PE	0	0	6	37	79	122	146	132	90	51	12	0	675
Illinois	P	49	48	68	74	90	93	84	80	76	67	59	50	838
Springfield,	PE	0	0	12	47	93	139	160	138	94	52	12	0	747
Illinois	P	52	54	77	88	107	106	78	74	85	68	62	51	902
Evansville,	PE	0	3	15	46	92	141	169	144	100	49	15	2	776
Indiana	P	98	82	105	99	101	101	85	82	80	70	88	85	1076
Indianapolis,	PE	0	0	12	47	93	135	152	135	94	49	12	0	729
Indiana	P	77	65	96	93	100	107	95	82	82	69	82	73	1021
Davenport,	PE	0	0	7	44	89	130	152	132	89	46	9	0	698
Iowa	P	39	39	59	73	97	108	88	90	89	61	48	38	829
Des Moines,	PE	0	0	6	44	91	130	157	136	90	46	10	0	710
Iowa	P	29	29	48	70	110	95	85	92	84	60	40	30	772
Garden City,	PE	0	1	19	48	90	133	160	147	99	49	13	0	759
Kansas	P	8	23	24	53	64	80	75	55	47	32	18	17	496
Wichita,	PE	0	0	15	53	92	145	172	158	103	55	15	0	808
Kansas	P	21	30	45	74	110	114	85	77	79	61	38	26	760
Bowling Green,	PE	3	5	27	57	104	145	165	150	106	56	20	5	843
Kentucky	P	122	101	130	114	112	99	106	92	81	75	100	107	1239
Lexington,	PE	0	3	19	50	92	134	150	137	102	40	18	2	748
Kentucky	P	112	83	113	90	94	107	84	85	70	61	82	91	1072

WATER BUDGET

FOR________________

	J	F	M	A	M	J	J	A	S	O	N	D
P												
PE												
P-PE												
ΔST												
ST												
AE												
D												
S												



Water Pollution Investigation

Earlier in the SAVE program, the water problem in the Valley was discussed in terms of its sources and scarcity. This enrichment unit is designed to provide some insights into the health aspects of water - its supply, pollution and re-use.

The Nature of Pure Water (c. Dow Chemical Company)

Materials: eye droppers
drinking water
one quart of:
- a) fresh tap water
- b) tap water after setting for 24 hours
- c) well water (safe for drinking)
- d) ditch or canal - label sample jars with letters only; don't tell students what they are.
- e) rain water
- f) distilled water
- g) diluted vinegar
- h) diluted NaOH (caustic) solution - 1 pellet/quart

Before you start! Two or three drops applied directly on the tongue from an eye dropper provide an adequate taste sample. Sip the water; DO NOT swallow it. Have students rinse out their mouths with water after each taste. Each student should see, smell, taste and feel each sample and then describe it. Fill in the following chart, answering "yes" or "no".

Sample	A	B	C	D	E	F	G	H
does it look good?								
does it feel good?								
does it smell good?								
does it taste good?								

Conclusion:

1. Which sample looks, smells, feels and tastes best?
2. Which is the best for drinking?
3. Which is worse?
   Explain what each sample was and how it can be improved by treatment?
   The vinegar (acid) feels "squeaky". Bases are slippery. If it isn't either, it is generally neutral.

Answer to Question #3

Water treatment for the various samples. (Samples A-G)

a. none
b. none
c. Chlorination and/or aeration and action.
d. Chlorination plus settling aeration and action.
e. Chlorination usually is necessary.
f. Add mild basic salts to neutralize acid - allow to settle and neutralize, chlorinate.
g. Add mild acid to neutralize base; allow to settle and neutralize, chlorinate.

Water Pollution Investigation - The Effect Of Sunlight And Time On Water Purification. (c. 1971, Dow Chemical Company)

Materials: One quart of a soapy dish of water and a dish of tap water for each group.

Procedure:
a) Note the appearance and odor of both samples at the beginning of the investigation.

b) Place both jars in a quiet area out of the sun.

c) Let students hypothesize as to what will happen in each of the jars by the end of the hour and in 24 hours. Record observations next to the hypothesis.

	1 hour Hypothesis/Observation	24 hours Hypothesis/Observation
A		
B		

1. Has anything settled out?
2. What does this mean to the community?
3. Is dish water good for people to drink? Why or why not?
4. Any grand conclusions?

Water Pollution Investigation - The Effect of Aeration And Filtration On Water Purification

Materials:
previous samples of soapy dish and tap water
filter paper (paper towels will do)
funnel
2 aerators from a fish aquarium
empty container for each sample

Procedure: Pour water into separate containers from each jar through the fitler paper shaped into the funnel. Put the aerator tube into this filtered water for one hour, 24 hours. Note any changes in appearance or odor.

Conclusions: What effects does settling, filtration and aeration have on the appearance of each jar of water? Any grand conclusions?

Soil Management and its Contribution to Water Pollution (c. 1971, Dow Chemical Company)

Materials: 2 pie tins
enough soil to fill 2 pie tins evenly
grass seed
2 containers to catch run-off water

Procedure:

a) Sprinkle grass seed on one pie tin with the soil in it. Press the seed into the soil and moisten well. Place in sunlight and water twice daily. Let it grow 2-3 weeks. (As an alternate to actually growing the grass, use a piece of sod approximately the size of a pie tin.)

b) Set pie tins (one with soil and grass and the other with soil alone) on a slant on the edge of a table with the catch basins on the floor under them. Sprinkle equal amounts of water on the two pie tins. Compare the amount and quality of water in each catch pan.

Conclusions:

1. How can environment contribute to water pollution?
2. Is the logging or construction industry at fault in this?
3. What are some possible solutions to this problem?
4. How can you apply these results and problems to the desert?

Investigation on the Effectiveness of Methods of Water Treatment**

Sample	Total Phosphorous (mg/liter)	Total Nitrogen (mg/liter)	Degree of Algae Growth	
			10 days	30 days
a. lake water alone	0.01	0.42	11	111
b. lake water + filtered raw sewage	0.07	1.18	111	1111
c. lake water + 4 ml. treated sewage from secondary sewage plant	0.14	1.18	11	111
d. lake water + 4 ml. sewage + special removal of phosphorous compounds	0.02	1.13	1	11

(Chart Cont'd.)

e.	same as d except phosphorous compounds added back after treatment	0.14	1.13	1	111

(** It will be necessary to discuss with class various methods of water treatment)

Polluted lakes usually have a heavy growth of algae. This often looks like a green scum on the water. The many live algae and dead and decaying algae give off a rotten, fishy smell.

The exact cause of heavy growths of algae have been discussed and argued for years. Scientists don't yet agree on the cause. Man has polluted water with many substances. Two chemicals are usually blamed for the great increase in algal growths: nitrogen and phosphorous compounds. The data in the above figure is from a laboratory experiment. It was designed to test the importance of these compounds. Algae were grown in the test containers in the light at 22 degrees Centigrade. One set was grown for 10 days and the other for 30 days. The colors indicate the colors of the filters through which the algal growths were passed after 10 and 30 days. If only a few algae grew in the water, the filter was light-colored. If many grew, the filter was a bright green.

1. How do steps b and c relate to specific types of water treatment?
2. How effective are b and c in removing nitrogen and phosphorous from the water?
3. How is the nitrogen and phosphorous content of the water related to algal growth? Explain completely. You will probably have to do some outside research to come up with the answer.
4. Is nitrogen dangerous as it leaches (look it up) down through agricultural soils? If so, how? How much nitrogen based fertilizers are used on agricultural fields yearly in the Valley?
5. Where does the majority of phosphates in polluted water come from?
6. Does step d successfully remove the phosphates? What happens to algal growth after phosphate removal? Why?
7. Check with Water Sanitation People. How important is phosphate pollution of Valley waters? Will it continue to be this kind of problem or is it getting bigger? What can be done to stop this problem?
8. Tertiary water treatment (step d) is expensive. Suggest a better alternative to phosphate removal from polluted waters.
9. What are the economics of building another sewage treatment plant similar to the Deer Valley one?

10. At existing sewage load rates (find out what they are), how many more people would another plant accommodate? Is this enough for metropolitan Phoenix?

11. Ideally, how many of these facilities will Phoenix need in the next 25 years? Where would you place them and why?

12. How much of an increase in taxes would these facilities mean? How could more efficient use of the plant and its by-products offset this rise in taxes?

13. What is public opinion in relation to these proposed facilities?

14. What would the recommendations of your committee be with regards to future expansion and construction in this area?

15. Go on a tour of the Deer Valley sewage plant.

16. Explain the various stages of sewage treatment, what they do and why they are necessary.

17. Does Phoenix face any specific problems in water treatment? If so, what are they?

SUPPLEMENTARY READING - WATER

From water came life. And life continues only because there has been an adequate supply of usable water. In spite of the fact that we all know water is essential to our existence, we continue to view it as an expendable, easily renewable common good. Not even high city water prices have completely destroyed the idea that water is a free public good. If one had to depict the "American view" of water, it would be as a unit of disposal - as, in fact, the ultimate disposal system. Although most people would not admit it, this idea is implicit in the way we act.

Few people are so concerned about industries in their area pouring waste into the waterways that they are willing to make the necessary effort to stop them. Even fewer are willing to try to make their communities stop polluting a river with human wastes. Witness, for example, the shortsightedness of towns in Florida which are either already dumping sewage into the ocean or are seeking permission to do so. When the beaches become unfit for swimming and the water is devoid of fish, will they apply for a federal grant to study why tourists no longer fill their motels? Even when many Americans are aware of industrial pollution, they are unwilling to challenge the industries, especially if it comes down to the hard crunch: jobs or water pollution. Some industries, aware of community fear of the loss of a plant, undoubtably use the fear as a leverage to gain time or avoid any clean-up action at all.

Of course, it is easy to flail out at industries and communities for acting as if water existed for disposal of wastes. However, we often overlook the individual's obligation to care for public property and recreational areas. For example: walk along a stream and look at the beer cans. Walk along the beach of a lake or ocean and look at various items that have been thrown away. Watch people on pleasure boats throw garbage overboard or flush human waste straight into the water. Americans as individuals are just as guilty of using the waterways as a disposal system as the industries. The first step in cleaning up the water is for each of us to quit viewing water as a public wastebasket and start defining water as a scare natural resource.

It is often assumed that water is an abundant part of nature and exists for man's most expedient use. Many people still use water as if it were inexhaustible, with no consideration for others who must use the same water. "Besides", many people assert, "just look at the vast quantities of water in the oceans we haven't even started to use yet." This attitude is an illusion. This water is not now generally available for us to use. In spite of highly publicized progress made in desalination, the actual amount of converted sea water is insignificant in relation to total need. The feasibility and desirability of depending upon the seas for fresh water is questionable. One perspective is that the money and effort necessary to desalt sea water might be better used in cleaning up our available but polluted fresh water, as aptyy stated by Frank Graham, Jr., in Disaster by Default:

> Sea water is actually "contaminated" to a higher degree than our waste water, its concentration of salts exceeding the concentration of sewage in our effluent, and is thus more expensive to refine. Perhaps more important is the fact that by advanced treatment of wastes we are solving two problems in one process: We are providing ourselves with a new water supply while cleaning up our waterways.

In the United States, the quantity of water used is so large as to be almost unbelievable. Howard G. Earl gives the following figures of water usage in the United States:

> In 1990, this country used 40 billion gallons of water daily. Consumption today runs between 75 to 100 billion gallons every day. It is estimated that by 1980 daily water consumption will reach 150 to 200 billion gallons.
>
> How do we use water? It's estimated that a home with running water consumes at least 60 gallons a day per person. Broken down into more understandable figures, we use five gallons daily to wash, shave, brush our teeth. Every minute you stand in the shower with the water turned on, you use at leave five gallons, and each time you flush a toilet five to seven gallons of water are used. The home-maker requires 27 gallons of water for all three cycles in a load of laundry. Air conditioners, garbage disposals, and automatic dishwashers place a heavy demand on the water supply.
>
> Turning to the farm, the combined consumption of a cow, hog, sheep, and chicken will average about 40 gallons of water a day. It requires 375 gallons of water to grow a one-pound sack of flour. A one-acre orange grove in California will use 800,000 gallons of water. And more than 77 billion gallons of water a day are pumped from rivers, reservoirs, and ponds in the widespread irrigation network that feeds Western agriculture.
>
> But the greatest user of water today is American industry. The figure used becomes so astronomical that it becomes meaningless stated in total amount of gallons. Another way to explain industry's use of water would be to use comparisons with agriculture per capita. Industry's water use today is placed at about 900 gallons per person in this country per day, as compared to agriculture's 700 gallons per person daily.
>
> Reducing this water usage to specifics, it takes 236 gallons of water to make one gallon of alcohol; 1000 gallons to make one pound of high grade paper; 600,000 gallons for a ton of synthetic rubber; 29 million gallons for the 30,000 pounds of aluminum required for a bomber.

To this, we may add other industrial uses of water such as 18 barrels to refine a barrel of oil and 300 gallons to make a barrel of beer.

As with all forms of pollution, water pollution is as much, if not more, a human problem as a technological one. We must stop viewing the solutions only in terms of technology and begin to realize certain facts underlying the whole problem: there are too many people; these people are using limited resources; and the public holds attitudes and behaves in ways that contribute to the problem. Until individual concern and responsibility become the basis of action, the water pollution problem will remain unsolved and worsen.

Taken from Society and Environment: The Coming Collision by Rex R. Campbell and Jerry L. Wade, published by Allyn & Bacon, Inc., 1972. pp. 64-67.

ENRICHMENT UNIT 3 - EDUCATION

Students are asked to review the data on schools from the Phoenix Comprehensive 1990 Plan in the data bank. Answers to the following questions will then be developed in a group activity in relation to planning for education facilities on their land use map.

Questions: (A look at the present)

1. Does the public have access to the schools during non-school hours?

2. What plans exist for adult education classes?

3. Is there a public library, theater, art gallery available for each community?

4. How accessible are schools to children? Can students walk safely to school without crossing a major road? Does the school district provide transportation for the students?

Questions: (Planning for the future)

1. What community cultural facilities and activities need to be planned for in an ideal city?

2. How can education facilities be used to foster a sense of neighborhood belonging?

3. Should schools provide recreational activities and facilities to the public, making them accessible and available to all, or should that be the responsibility of other city organizations?

4. Do your schools fit in with the natural terrain? Or have they upset the ecological balance of the area?

5. What noise, air and water poplution controls be considered in building schools?

6. Should you plan for interaction and participation of residents on many levels in the community schools?

Statements for debate:

1. Our schools should be founded on the concept of equipping young people to do something about "What is going on in the world" -- notably, the things which bother them the most, including war, injustice, racial conflict, and the quality of life.

2. At present, the conventional school is a hostile place, especially to urban "disadvantaged" children.

3. Schooling need not confine students to sitting in a classroom. The whole city should be a continuous "learning laboratory", with the immediate community as the source of immediate reward for all activity.

Examples:

A. Community planning and action programs, running from information services that could include newsletters, magazines, and film, to rat extermination, with a bounty paid for each rat killed, and awards for better approaches to the problem.

B. A range of services geared to immediate daily problems, including repair services for household appliances and equipment.

C. A range of "cultural" services, including student - produced musical and dramatic programs, puppet shows, films, television programs, etc., on a continuing basis; they could be city-wide talent programs with the best performers and performances being showcased on a weekly TV program, or in other community facilities.

D. A range of "athletic" services (possibly adjunct to the "cultural" program) again on a city-wide basis; this might be of an "intramural" type, possibly under the aegis of a City Athletic Club, with a continuing round-robin series of contests; placing participants on an Olympic team might be one of the objectives of such a program.

E. A range of services in or to city agencies -- hospitals, police, fire, sanitation, parks, museums, etc. (this might be extended into private business.)

(Statements taken from Teaching As A Subversive Activity, Postman and Weingartner, New York, Del Publishing Company 1969.)

Supplementary Reading - Schools

In any community it is impossible to talk about community facilities without some reference to -- schools -- perhaps the most important facility of all. No single element of the Comprehensive Plan is more important in improving Phoenix's total environment and expanding human opportunities than the provision of high-quality educational facilities. In Phoenix, the selection of a place to live often depends on the quality of a local school district.

Existing Situation

Within the Planning Area there are portions of 23 elementary school districts and seven high school districts, which contain 123 elementary and 16 high schools. In the last ten years, school enrollments have been increasing rapidly in the metropolitan area which includes the cities of Phoenix, Scottsdale, Glendale and Tempe. For example, in 1960-61 the average daily attendance for elementary and high schools was 121,000; in 1965-66 there were 155,000 students: in 1966-67 this figure rose to 160,000 a 32% increase since 1960.

A comprehensive program for future school planning in metropolitan Phoenix is hampered at the present by the multiplicity of school districts. There is an overlapping of elementary and high school service areas which causes an apparent duplication of facilities and services. There are wide variations among various elementary and high school districts in the number of students they must educate and their ability to finance the necessary facilities and manpower to accomplish the task. The relationship between the assessed valuation available to the school district to tax and the number of students they must provide for is significant. One school district will have an assessed valuation tax base of $12,000 per student while others will be below $6,500. Under present conditions, an equal tax base between the various school districts is impossible. This has serious implications on the quality of education.

Each school district in metropolitan Phoenix follows its own policies regarding planning standards and site selection. The haphazard shape of school district boundaries has resulted in dividing cohesive neighborhoods as well as placing some schools near the edge of their service areas. This pattern has caused excessive walking distances for some Phoenix elementary and high school age children.

Objectives

There are three basic kinds of educational goals -- cultural, economic and civic. The cultural objectives are aimed at enabling a person to acquire information to lead to full life. The economic objectives are concerned with one's preparation to make a living. The civic objectives are related to developing a degree of understanding of the political, economic, and social problems in order to participate in their solutions.

Physical facilities designed to inspire the young and to offer a variety of opportunities for educational development are important goals to follow. Proposals for location and distribution should be based on standards calling for convenience, multiple use, and good design.

Site Selection

The job of selecting a school site is so important that an analysis should be made not only of today's needs, but of the future planning program of both the school and the community. Selecting a school site involves financial, legal, personal, political, public relations and communication problems.

The basis for selecting and developing a school site should be sufficiently broad and flexible to allow for variations in the character of the school district, the size and type of plant to be built, and the nature of the educational program and activities to be accommodated. In general, a desirable site which will satisfy most educational programs must be appropriately located within the pattern of existing and future school facilities and population growth, have sufficient aesthetic qualities, and have suitable topography and soil characteristics. Undesirable elements such as heavy traffic and unusual dust, odor, or noise annoyances close to school sites should be avoided.

An important principle involved in good site selection is central location --- convenient accessibility to the area that it must serve. This is usually measured in terms of the time it takes for students to get from home to school.

Another factor in school site selecting is the park-school concept. In Phoenix today, a number of schools have been designed for multiple use of the site by both a school facility and park. In this way, the school site can function as a logical neighborhood center catering to both the educational and recreational needs of the neighborhood. Joint utilization of the site permits greater efficiency and reduces the total area required for both the school and neighborhood park.

Future Needs

By 1990, there will be approximately 207,000 elementary school-age children in the Phoenix Planning Area -- an increase of 115,000 over the 1965 figure -- and about 81,000 high school-age children -- an increase of 42,000 over the 1965 figure. Translated into schools, this means at least 115 new elementary and 11 new high schools for a total land requirement of 2,275 acres.

The 1990 School Plan proposals indicate general locations based on anticipated residential development and the ensuing school needs. In the selection of new school sites, vacant land was used wherever possible.

There will be a diligent need to continually update the recommendations of the 1990 Plan proposals. Changing teaching technologies, school plant construction, population shifts and the ability of the people of Phoenix to finance new and renewed facilities are only a few of the situations that require a continued planning effort.

(From the Comprehensive 1990 Plan for Phoenix, Arizona.)

ENRICHMENT UNIT 4 - PHOENIX HOUSING

1. The student will demonstrate an understanding of the effects of poor and inadequate housing on human health and morale by:

   a. Investigating and mapping out the areas of blighted and slum housing in the city of Phoenix.

   b. From the State Hospital and private valley hospital records see if there is a relationship between psychological difficulties and residential location. In other words, are certain areas of the valley plagued with higher levels of social disruption.

   c. From Police Department statistics, correlate crime and socio-economic and ethnic levels.

   d. From Phoenix Union High School District data, compare drop-out rates in various Valley areas. Is there any correlation with socio-economic status, housing in the area?

2. Prepare and administer a questionnaire on attitudes and values of Phoenix citizens (all socio-economic and ethnic classes) on urban sprawl and its concomitant (not always) dull living.

   Sample questions might be:

      a. Is the suburban growth of Phoenix developing in an orderly manner?

      b. Does existing residential development have an effect on the life style of the inhabitants?

      c. What would you consider the ideal residential community?

3. Compare the advantages and disadvantages of ALL types of public and private housing.

4. What is the PAD plan and zoning plan (See Phoenix Comprehensive 1990 Plan) for the residential, commercial, industrial, and agricultural areas of the Valley. What are future plans for the city in each of these areas? Do you agree with these planned usages? Why do you agree or disagree?

5. Zoning.

      a. Determine major land usages within the community by percentages and major concentrations within the city and the study area. (See Phoenix Comprehensive 1990 Plan)

         1) residential
         2) commercial
         3) industrial
         4) public lands
         5) semi-public lands

b. Conduct a survey as a City Planning Committee to determine the various types of housing available, they don't necessarily all have to be in use.

c. Investigate city ordinances - zoning, building, subdivisions, health. What are the purposes behind each? How were they arrived at? Which ones need to be changed? Does the method of arriving at them need to be changed? Prepare alternative ordinances to the ones that you think are weak and work out a plan to put these changes into effect.

d. Appoint study groups to examine small land areas (3-4 blocks) with which the group is familiar and plan for and develop a plan for future land use in the area.

   1) sketch the area with all existing buildings and land use.

   2) consider future land use that will be compatible with present land use.

   3) sketch future land use proposals and justify your actions to a mock city council and homeowners in the area.

e. Community Inventory (from Earth Tool Kit, published by Pocket Books, N.Y., 1971) pp. 330-332. See page for Environmental Checklist.

   1) Industrial Plants

      a. Where are the industrial plants located in your area?
      b. What are the sources of their raw materials?
      c. What types of effluent are produced at each plant?
      d. Are controls being used to regulate the effluent?
      e. Are other means of disposal available?
      f. Do any of the plants emit large quantities of smoke?
      g. Are smokestacks working at night that don't function during the day?
      h. Are there air and water pollution standards for your area? If so, what are they?
      i. Are they enforced?
      j. Are the workers satisfied with in-plant environmental conditions?
      k. Are pollution control devices being used?

   2) Power and Sewage Lines

      a. Are power lines over head?
      b. Are all future power lines zoned to be underground?
      c. Are current or projected power lines blocking scenic views?
      d. What kind of power plant serves your area?
      e. If it uses fossil fuel, is it low-sulfur content?
      f. Does the company advertise "live better electrically?" Have there been any company advertising designed to answer the charges of environmentalists? What?

g. When are the peak hours for electricity usage in your area?
h. Where does the community water supply originate?
i. Are sewage lines adequate for the neighborhood needs?
j. Is there a primary sewage treatment plant? Secondary? Tertiary? If so, how many and where?
k. Are sewage plant by-products re-usable?
l. Are they being re-used?
m. Are there septic tanks in your area? Do they drain properly?
n. Are adequate precautions taken to prevent the septic tanks from draining into clear water wells? What are they?
o. Are all drainage products prevented from draining into the good water supply?
p. How many and what chemicals are used to make the water suitable for drinking purposes?

3) Transportation

a. Where are the main thoroughfares located?
b. Are there scenic easements protecting the community from the noise and view of freeways and major highways?
c. Is billboard legislation in effect? What?
d. What new roads and transportation systems are being planned?

4) Property

a. Who owns what lands within the community?
b. What urban renewal projects exist?
c. What areas of open space exist within the urban area? Are they protectively zoned?
d. Are any agricultural lands zoned against development? What and where?
e. What pesticide spraying programs exist? What, if any, measures are being taken to restrict or limit their use?
f. What recreational areas exist?
g. What future development plans exist?
h. Are cultural and educational facilities adequate?

5) People

a. What are the main cultural and ethnic groups within the urban community?
b. Are these groups located in specific sections of the community? If so, where?

ENVIRONMENTAL CHECKLIST: Rate Your Community

This form may be used to survey the degree of pollution in your community. After rating the community in the various categories of pollution, you can use the third column to indicate whether government, private business, or individuals are responsible for the problem. In the fourth column you can suggest possible remedies.

POSSIBLE SOURCE OF POLLUTION	RATE PROBLEM IN YOUR AREA*	WHO OR WHAT IS RESPONSIBLE?	HOW CAN PROBLEM BE ALLEVIATED?
Sewage Disposal			
Industrial Pollution of Streams			
Air Pollution by Factories, Incinerators, etc.			
Motor Vehicle Exhausts			
Auto Junkyards			
Dumping in Vacant Lots			
Garbage Disposal			
Agricultural Pollution			
Construction/Mining Projects			
Traffic Noise			
Aviation Noise			
Other Forms of Pollution			

*Serious, getting worse, minor problem, or no problem

This survey form is presented for use with the special issue. See p. 7 for suggestions on its use. American Education Publications grants permission for reproduction of this page for classroom use.

ENRICHMENT UNIT 5 - PHOENIX INDUSTRY

The teacher should ask each group to look over the data in the data bank relating to this topic.

(As part of this unit on Industry and Employment, excerpts from the Phoenix Comprehensive 1990 Plan have been included to illustrate the Planning Departments Future Industrial Policies.)

The following is a list of questions each group should consider in the planning stage before they select the location of light and heavy industry for their model city:

Questions:

1. What is the present labor force and future growth projections in the city of Phoenix that you must provide for in the amount of industry?
2. What industry is already located in the area?
3. Where is the industrial land in relation to transportation arteries?
4. Are similar types desirable for the future?
5. What kind of environmental restrictions are placed on the industry already there?
6. Where is the industry located in the city?
7. How accessible are commerical offices and industrial buildings to delivery and shipment, to the employees and customers?
8. What provisions have been made for off-street parking, landscaping and commercial signs?

The character and special demands of industry for space and transportation have recently resulted in the setting aside of large suburban tracts of land that have been planned and designated only for industrial uses and diversified businesses. Planned industrial districts contrast dramatically with industrial districts of the nineteenth century. In the latter, residential and mixed use are reminders of the industrial cities of England and of the nineteenth-century industrial cities of the United States.

Students may wish to consider the following points before they plan industrial land use.

Statements for discussion and debate:

1. Production should serve the immediate environment in which it is located to scale down the need for wasteful long-distance transport of goods.

2. Working people should regard the kind of goods they produce, and how much they cost in terms of environmental destruction, as equal in importance to the size of their paychecks.

3. Work places should be scaled down in size, redesigned as multiple-use environments, and dispersed throughout communities so as to bring the job to the people, and not the other way around.

4. Industrial workers should insist on conversion to non-polluting production methods. A non-polluting factory environment means that people can live near where they work.

5. Working people should insist on a reduction in working hours to give everybody more time to live in his community.

6. Work-connected facilities, such as day-care centers for the children of working mothers, should be located in the living neighborhood rather than at the central factory.

7. Certain entire trades should re-think their present role in the environment. For example, we do not need to harvest and process massive quantities of new building materials.

When the teacher, as well as each group, feel they have given consideration to environmental concerns, as well as understanding problems of site selection of industrial land use -- each group should make provisions for such on their map (remembering to provide for the present labor force as well as desired future growth.)

Supplementary Reading - Industrial Element

EXISTING INDUSTRIAL LAND USE

The economic importance of industry today is increasing and major consideration should be given to industrial needs in a plan for development. The location and land requirements of modern industrial plants cannot be satisfied with leftover land. The broad objective of this section is to underscore the importance of industry in the Phoenix Planning Area and to clarify its needs and problems.

The Industrial Element of the Comprehensive Plan shows present and forecasts future industrial land needs. At the same time, it is concerned with the present problems of industrial land use, possible solutions to these problems, and future industrial development criteria. Industrial uses are comprised of all manufacturing, wholesaling, warehousing, agricultural services, and extractive industries such as sand and gravel.

Technology

Changing technology has had a profound impact on industry in the Phoenix Planning Area. In some industries (metals), new methods have raised production and lowered employment, while in other industrial activities technology has caused an increase in the demand for technical workers and a decrease in the need for unskilled laborers. The development of air conditioning has facilitated the growth of industries such as electronic manufacturing and metal extrusion in the Phoenix Area. Advances in modes of transportation have also caused changes locally. In addition to railroads, air freight and trucking have become major means of transporting goods. In many cases these faster and more efficient means of transportation have expanded the markets for locally produced goods.

Existing Land Use and Density

In the Phoenix Planning Area, 4,760 acres of land were used for industrial purposes in 1965. Eighty percent of all such land was located in South Phoenix in the vicinity of the Salt River bed. Most of the remaining industrial land was along the Black Canyon Freeway south of Grand Avenue and along Thunderbird and Deer Valley Roads. The exceptions to this pattern are the electronics firms which have located in dispersed areas throughout the Planning Area. Practically all of the industrial operations in South Phoenix manufacture locally consumed products, whereas most of the industrial activity elsewhere is devoted to the production of goods to be distributed nationally.

Future Location

Land needed for new manufacturing will be near existing manufacturing plants. Electronic manufacturers have preferred to build in outlying areas near freeways. Examples of this are the recent expansions of the Motorola, General Electric, and Sperry plants. While other manufacturers also prefer outlying areas, they are more concerned with rail access, as is shown by the Reynolds Aluminum plant in Southwest Phoenix. Because of this past pattern of growth, it is estimated that future land needs for the production of industrial goods will be in the outlying areas near transportation routes.

The wholesaling industry is mainly concerned with access to transportation routes. In order to facilitate shipments of goods from throughout the Southwest, a major trucking terminal is suggested. This terminal would provide close freeway access to accommodate the expected wholesale and warehouse activities in southwest Phoenix.

The current sand and gravel supply is expected to last through the present planning period. Because of the lack of knowledge as to where new deposits can be found or what to do with present locations once they are exhausted, further research is needed on this subject.

Future Land Use

The land requirements for manufacturing, one of the largest single-use activities, will increase from 2,300 to 8,820 acres by 1990. During this same time period the acreage needed for industrial services will grow from 1,880 to 3,880, an increase of 2,000 acres, while extractive industries will need approximately 2,000 more acres of land.

Future Industrial Policies

To provide for an orderly development of industrial activities, three policies are suggested: establishment of a Southwest Industrial Reserve, encouragement of planned industrial parks, and a realistic zoning policy.

The first approach is the creation of the Southwest Industrial Reserve. Currently, a number of industrial activities are scattered throughout this area. Manufacturing enterprises will function more efficiently and economically when located in large, contiguous blocks. This reserve will ensure that suitable sites are available to fill the demand for new industrial areas well into the future. The Southwest Industrial Reserve, located generally in the area west of 35th Avenue, east of 91st Avenue, north of the Salt River, and south of the Papago Freeway, would provide an area for industrial use that has superior industrial development characteristics. These include large land parcels, flat, flood free transportation access, and a compatible environment. This too, would be an ideal place for those industrial activities which exhibit obnoxious smells, noise, or other undesirable features. By allowing no incompatible uses, such as residential developments, to intrude within this area, a cohesive industrial area can develop; safe from land use conflicts with other uses. Another objective of the Industrial Reserve is to provide accommodations for some industrial activities that have by-passed Phoenix in the part because of the relatively small local and regional markets. Industrial activity in the Southwest Industrial Area will be dominated by industries that have a low employee density; that is, there will be a few employees per acre of use. Specific recommendations for various areas are shown on the map. Industrial development within the area should follow a contiguous pattern.

(From the Phoenix Comprehensive 1990 Plan for Phoenix, Arizona)

ENRICHMENT UNIT 6 - TRANSPORTATION

The teacher should ask each group to look over the data included in this "transportation element" taken from the Phoenix Comprehensive 1990 Plan. They should also review the model street system on page 152 of the data bank.

The following is a list of questions each group should consider in the planning stage before they select the transportation system:

1. What does the city of Phoenix supply to other communities?
2. What access does the city have to existing state or interstate highways?
3. How is movement within the community planned? Does a resident depend on an automobile to get to work?
4. What airport, railroad or bus facilities does the city have access to?
5. What consideration has been made for safety, for noise pollution due to trucks and cars?
6. Have pedestrian pathways, bicycle paths, parks, been provided for? Are they separated from vehicular traffic?
7. How are streets in the city of Phoenix determined by land surface?

Reading: "The Automobile" pp. 79.

After completion of the reading the students should discuss the following questions efore planning their transportation system.

Questions: (For discussion and debate.)

1. Is the continued building of freeways the best method of meeting the future transportation problems of Phoenix, Arizona?
2. What effect do freeways have as a whole on man's social institutions, organizations, and individual behavior?
3. Is it practical to get rid of the present engine and fuels altogether?
4. How should you plan your city's transportation system so that it will encourage people to change their life style and our values in the United States that are in direct conflict with the dictates of ecology?
5. How will land use be different in your city of the future in comparison as to land area devoted to automobiles compared to living space for people?
6. Have you considered other types of transportation such as bicycles, electric carts, when designing for traffic flow, building parks, one-way streets, and other related projects?

7. Do you desire to reduce present automobile usage? If so, how?

8. How will other means of transportation be made attractive to potential customers than the car?

9. What type of landscaping have you planned for in relation to your transportation system?

Supplementary Reading - The Automobile

Over fifty thousand Americans sacrifice their lives each year to the automobile. Over 2 million more are injured, many permanently. Not even war can claim to surpass this number of premature deaths and injury. The death rate from automobiles is greater than the combined death rate from falls, burnings, drownings, railroads, firearms, and poisonous gases.

The car is robbing the American people of their land, air, minds, and their very lives. It is becoming increasingly clear that solution of the transportation-automobile problem is of high priority if we are to come to terms with the environment, and with ourselves.

Automobiles insulate man not only from the environment but from human contact as well. They permit only most limited types of interaction, usually competitive, agressive, and destructive.

In Berkeley, each citizen has 28.1 square feet of parks. Each automobile has 968 square feet of roads. A full quarter of the city's land is devoted to the automobile - 17 percent for roadways and an additional 9% for driveways, garages, parking lots, service stations, car washes, and so on. The city of Berkeley, California is not unusual in its use of land.

Use of the automobile has made possible the extensive suburban sprawl so typical of today's American landscape, sometimes robbing the countryside of rich agricultural lands, and nearly always creating a monolithic and oppressive human habitat.

Each year, almost one million broken-down autos are abandoned along roadsides, in fields, and on city streets. They are creating immense problems, both aesthetic and ecological.

Sixty percent of all pollutants added to the air in the United States come from the internal combustion engine. (In 1967, 87.4 percent of the 14,000 tons per day added to the air above Los Angeles came from gasoline-powered motor vehicles.) The atmosphere around us has truly become a garbage dump. Even with control devices, automobiles produce more pollutants per passenger mile than buses or trains with uncontrolled engines.

As long ago as 1949, air pollution in Los Angeles County caused damage to crops amounting to almost half a million dollars. Today, spinach and a few other vegetables cannot be grown in the Los Angeles basin, and many of those which can are stunted and unhealthy because of the air pollution. A recent survey shows that smog is killing 100,000 acres of Ponderosa and Jeffrey pine trees in the San Bernardino National Forest sixty miles away from Los Angeles proper.

Although few specific diseases have been attributed to air pollution, there is no doubt that continual breathing of polluted air is injurious to health. The rate of lung cancer and emphysema among non-smoking city dwellers is several times that of their rural counterparts who breathe cleaner air. In central Los Angeles, about 10,000 persons per year are advised by their doctors to move from the city for reasons of health. By order of the Los Angeles Board of Education and County Medical Association, the school children inside or outside on smog-alert days, of which there were several during 1969.

The automobile is a versatile chemical factory that can produce almost anything you might wish to dial. Smog has lately been discovered to be the result of the action of sunlight on the incompletely combusted automobile exhaust gases, mainly carbon monoxide, the hydrocarbons, and nitrogen oxides. It has been demonstrated beyond a doubt that from 60 to 85 per cent of most city smog is caused by man's best friend, the effusive automobile. A recent scientific analysis of New York City's atmoshpere concluded that a New Yorker on the street took into his lungs the equivalent in toxic materials of 38 cigarettes a day.

Coming into this new knowledge which proves so distressing - that our dearest companion, the automobile, is completely incompatible with our health and well-being -- how long will we cling to it in this embrace of death? How long, we wondered will man continue to sacrifice his cities, his enjoyment, his life, because of the fetid breath of a monster never built for meandering in city streets with their stops and goes and halting, jammed traffic? An ungainly, unadaptable monster whose 80 mile an hour cruising speed was geared to the long sweep of thruways and not to the bumper-bumper creep among the city's steel canyons?

A group of mice exposed to the day-by-day Los Angeles air developed one and one-half times as many lung cancers as those who breathed clean air. A man is not a mouse -- usually. He has a bigger body; he may have more resistance, slower reaction. But everyday the air a human breathes comes in direct contact with an area twenty-five times as great as his exposed skin area. This is the exposure surface of the tender membranes that line his lungs.

Predicts sanitation expert A.C. Stern of the Taft Sanitary Engineering Center, Cincinnati: "By 1985, the U.S. Weather Bureau will be issuing daily air pollution reports as well as weather forecasts. People will be more interested in whether it will be safe to breathe than whether it will be rainy or sunny." Our only comment here is that his prediction is ten years too late.

Since most families have two cars already it is suggested that one of them be a small electric cart for city driving and the other a high-powered machine for the road. No, the electric cart will not leap forward like a rocket at a green light, but consider this: No more poisonous vapors, odors, smoke clouds, corrosion, gluey oils, inflammatory gasoline; accidents cut to a tenth, less noise, easier parking, the innovation of a relaxed kind of driving (Not to mention the cut in incidence of lung cancer, bronchitis, heart conditions, and smarting eyes.)

There are, in all, from 8,000 to 10,000 tons of gases, vapors, and solids being thrown into a large city's air everyday -- a generous two-thirds of it from the automobile -- to saturate the lungs of roughly two-thirds of the nation's population. Years ago, former Surgeon General Leroy T. Burney declared categorically that there is a "definite association between community air pollution and high mortality rates", a fact that is today universally accepted.

While cars get faster and longer, lives get slower and shorter. While Chrysler competes with Buick for the getaway, cancer competes with emphysema for the layaway. This generation is indeed going to have to choose between humans and the automobile. Perhaps most families have too many of both.

The preceding reading was taken from:

Robert Rienow and Leona Rienow, "38 Cigarettes a Day", The Environmental Handbook. (New York: Ballantine Books, Inc.,) 1970, pp. 113-127.

Kenneth P. Cantor, "Warning: The Automobile Is Dangerous to Earth, Air, Fire, Water, Mind and Body," The Environmental Handbook. (New York: Ballantine Books, Inc., 1970), pp. 197-213.

Supplementary Reading - Transportation Element

The objective of transportation is the safe, efficient, and convenient movement of people and goods. It enables people to carry on life's many endeavors at separate sites selected for these purposes. Transportation ties together all the vibrant parts of the urban area linking together neighborhoods, regions, and states.

Many people have come to Phoenix seeking a new way of life - a life with a freedom from constraint that is not available in older metropolitan areas. This is reflected by the spread-out development of the area, the low population density, a low building profile, and the great distance between centers of activity. Further, this is amplified by the desire of the people for a personalized type of mobility which has given use to rubber-tired oriented transportation. Thus, in the Phoenix Urban Area, the predominate method of travel for people is by automobile -- now and in the foreseeable future.

The development of an adequate transportation system is vital to the continued economic growth of the Phoenix Area. The great population growth of the 1950's generated many of the transportation problems of today; for this growth accelerated the needs beyond the ability to finance improvements.

The City of Phoenix has had the benefit of continuous transportation planning over the past several decades, and the entire urban area has benefited from a Major Street and Highway Plan that was adopted in 1960 and 1961 by the Arizona State Highway Commission, Maricopa County Board of Supervisors, and the City Councils of Phoenix, Glendale, Avondale, Mesa, Buckeye and Tempe. In 1965, the Valley Area Traffic and Transportation Study (VATTS) was established as an on-going transportation planning program for metropolitan Phoenix.

Transportation Planning and Land Use

The existing and projected land use pattern for the entire urban area must be the major consideration reflected in transportation planning. The essence of transportation planning is concerned with the safe, efficient, economical, and convenient transport of people and goods from one place to another. The transportation system should be so designed as to accommodate the future patterns of human activity work, shopping, leisure time, school, recreation, and personal. Therefore, the location and functioning elements which comprise the transportation system, i.e., freeways; major, collector, and local streets; air, rail, and ground terminals; must be mutually complementary if the Phoenix area is to remain healthy. Developing a balanced, integrated transportation system is a key objective of the plan.

Following the proposed general land use plan for the area is of the utmost importance; for, if the basic plan is not adhered to and other types of land use are allowed to develop, i.e., a large regional shopping center instead of a low-density residential development, the transportation plan could be seriously affected. Further, if the means of ingress to adjacent developments are allowed, the efficiency of a street can be affected and, at the same time, cause intolerable congestion. Traffic congestion contributes to the blighting of adjacent areas and can result in costly widening and often destroys the productive use of the land for which the transportation system is intended to serve.

Therefore, the success of the Major Street and Highway Plan and the entire Transportation Plan depends on how well the general land use plan is adhered to.

Aesthetics

In the development of future streets and highways, great care should be exercised to preserve the scenic qualities of Phoenix. Many possibilities exist in relating highway design with the natural and man-made landscape in order to create a more pleasant environment. Both the view of the street or freeway and the view from the street or freeway should be carefully developed.

Many of our major streets and highways have been designated as parkways. Several have been landscaped already and others will be in the future. A total design study is now underway for the proposed East Papago Freeway; and is concerned with the effect on the area that it will pass through.

Elements of the Transportation System

Within the total transportation system, six basic elements were studied; the major street and highway system, public transit, air transportation, railroads, pipelines, and parking and terminal facilities. These elements together form the transport system today and form the foundation of the future.

Freeway System

The development of the modern freeway, a controlled access, multilaned attractive major highway has been a great advance in the safe, convenient movement of people and goods. Freeways are an essential element to the development of the total transportation system. The freeway system is superimposed on the major street system to function as the prime mover of traffic. The great advantage of freeways can be summed up by one statement -- one lane of a freeway will carry three times as much traffic at twice the speed and three to five times safer than one lane of a major street.

The lack of freeways has put an excessive amount of traffic on the major street system. This overloading of major streets is not only detrimental to them and abutting property, but also to the collector streets and, in some cases, local streets; because as the major streets become congested, motorists seek other routes, thus forcing undesirable through-traffic into residential neighborhoods.

Freeways, if properly designed and properly planned, can add much to the quality of urban community life. By planning for the sociological impact as well as the aesthetic characteristics when merging a freeway system into the physical fabric of a community, many economic and developmental benefits can be realized. The lack of an adequate freeway system can be expected to have an effect upon economic development and orderly urban growth.

Greater emphasis should be placed on freeway right-of-way acquisition in advance of development. In this way, substantial public savings can be realized, and other land planning benefits accrue when highway rights-of-way acquisition precedes, stimulates and gives guidance to development. This early acquisition avoids the need to tear down relatively new buildings and uproot neighborhood patterns and businesses.

Public Transit

The existing public transit system in Phoenix consists of a privately owned bus company. There are about 16,000 average daily transit trips accounting for about one percent of the total person trips in the urban area (Figure 63.) Buses provide transportation for people who cannot afford a private automobile, who are unable to drive, and who choose transit as an alternate means of travel.

The existing and projected low densities of land use development, anticipated high levels of automobile ownership and present trends in transit use do not suggest a greatly expanded role for public transit in the Phoenix Urban Area. In the future, as population densities increase, a higher demand for public transit may develop to serve the urban area. It should be noted that public transit and automobile transportation cannot be considered as simple alternatives, for each has its appropriate role in serving the travel requirements of the urban area.

There is currently discussion, both nationally and locally, on rail transit. A recent report by the U.S. Department of Transportation to Congress says: "Five U.S. cities now have rail transit systems in operation, a sixth has one under construction, and five others are seriously considering such systems for the future. In four of the five urban areas considering rail rapid transit systems, estimates are that such systems would serve about five percent of the urban area's total daily person trips, and ten percent of the area's peak-hour trips. (Estimates for the fifth area, Los Angeles, are about one-half of these values.)"

The Phoenix Urban Area projected size, density and form would not support a rail transit system in the frame of present long range planning, through 1990. Rail rapid transit is primarily intended to serve centrally oriented commuter trips along dense travel corridors, a situation which is not foreseen for Phoenix. However, there should be periodic re-evaluation of the transportation system and its various modes with due consideration for the desires of the people. In the future, if it appears that citizens attitudes change in favor of increasing density of living or as we approach 2,000,000 people, a broad base mass transit study to explore the potentials of all transportation modes should be undertaken. Thus Phoenix can take advantage of new technology and experience of other urban areas in the field of mass transit over the next decade.

Railroads

Freight service to nearby markets is offered by two transcontinental railroads. Although Phoenix is not on the main line of either railroad, it is not anticipated that Phoenix will suffer in the future because of a lack of fast through service, as both lines presently offer adequate service.

It can be expected that, in the years ahead, the railroads will still continue to be the major mover of freight on a ton mile basis. Passenger use of railroads into Phoenix has decreased to the point where one railroad recently requested discontinuance of passenger service which was established in 1894 through Phoenix. The railroads now find they have been challenged by truck and, to a lesser extent, by air freight as the top freight carriers. However, the volume of freight handled by railroads is on the increase.

Growth of industrial activities in the Phoenix Planning Area will be enhanced by the fact that adequate rail spurs can be developed easily, especially in the Southwest Industrial Reserve and along the Grand Avenue industrial corridor.

Pipelines

Pipelines are an important part of transportation as a mover of goods - liquid and gas. Pipelines transport all of the natural gas used in the Phoenix Urban Area. Pipelines have become a major source of petroleum products. The complex domestic water distribution system and canal system for irrigation can also be considered a mover of goods.

Parking and Terminal Facilities

Phoenix obtained most of its growth in the last 15 years during a period when the automobile was recognized as the primary means of transportation. Providing adequate off-street parking as an integral part of all types of development, from shopping center, to high-rise, to single-family residences is absolutely necessary. City ordinances require adequate off-street parking except in the core area. Progressive developers in some cases have been even exceeded these requirements. In the downtown area, the parking demand has decreased considerably due to the decentralization that has taken place.

Future parking demands will be important where a change in transportation mode is involved. For example, at Sky Harbor Airport, it will be necessary to expand greatly the parking facilities to take care of the exceptionally high increase in airline passengers which is anticipated. Constructing parking lots next to freeway interchanges in conjunction with express bus service on freeways may be needed. Continued development of off-street parking to adequately serve the land use is absolutely essential as part of the total transportation system.

Conclusion

Older communities developed when the predominant mode of transportation was some form of steel wheel and rail facility, either street car, elevated, subway, or commuter railroad systems. The newer cities, especially those in the West, have essentially had their population growth in the automobile era. Thus, they present a very different picture with regard to the urban land use pattern. Phoenix is one of the nation's prime examples of such a city, in that it possesses a very dispersed density land use pattern. This dispersal has allowed Phoenix to grow with fewer acute street and highway problems than cities of comparable size, even though it lacks on adequate number of freeway miles open to traffic.

The rapid population growth of Arizona in the last decade and the increasing urbanization that has come with this growth has brought with it a rapidly developing need for adequate streets and highways. Streets, highways and freeways touch every aspect of Phoenix's economy, development, recreation and tourism, and the daily life of our citizens. Historically, our Nation, our West, our State, County and our City have developed where there is adequate transportation.

NEVER HAS THE NEED FOR AN ADEQUATE STREET AND FREEWAY SYSTEM, WITH RELATED TERMINAL FACILITIES, BEEN MORE ACUTE THAN IN OUR MODERN, AFFLUENT SOCIETY WHICH DEMANDS SAFE, EFFICIENT, AND CONVENIENT MOBILITY .... MOBILITY - PHOENIX STYLE.

(From the Phoenix Comprehensive 1990 Plan for Phoenix, Arizona.)

ENRICHMENT UNIT 7 - CITY GOVERNMENT

Decisions made in the 70's will determine whether we will destroy or save our natural environment for ourselves and future generations. We are involved in a similar life/death struggle to maintain quality in our man-made environment. In both cases we are reaping a harvest of devastation that will not support life. The pollution of water supplies and the general destruction of ecological balance matches the deterioration of urban areas with resulting social ills. It is becoming increasingly obvious that the state, in cooperation with its cities and counties, must play a more positive and creative role in shaping future growth.

The idea of local government is one of the great traditions of our American way of life. Our people have always felt that local problems frequently can be solved best through local effort.

Objectives:

This part of the simulation is intended to familiarize students in the ninth through twelfth grade with the major problems that confront city governments; such as transportation, civil rights, crime, education, housing, pollution, and poverty. Behaviorally, students should, after working the program be better able to understand, and interpret newspaper and TV reports on urban affairs, and eventually to participate in city government as enlightened voters.

Students learn, through personal involvement, the conflicting interests which have to be reconciled in framing a city government.

Students understand that the resulting structure of their city government must accommodate as many different interests and viewpoints as possible.

Students will understand that it takes a city government to achieve the most efficient and orderly pattern of land uses from a social, economic and cultural point of view which achieves both convenience and variety.

Assignment:

After a review of the discussion questions and of the several types of city government each group will select the type they feel will be best suited to carry out the objectives they wish to accomplish in this program.

Notes to the teacher:

The teacher should divide the class into groups to consider the discussion questions, having each group concentrate on one or two questions per class period if time permits, then call on the students to report back to the class as a whole after they have had sufficient time to examine the questions.

Each group can appoint a secretary to take notes for the group's report, particularly if each group is working on different questions. The group should develop a general statement in answer to each question and indicate what evidence led to their statement.

In the early class sessions try to instill good discussion and decision making techniques.

Alert students frequently to the value of keeping their over-all objectives of good government and data limitations for the city of Phoenix in mind, as they formulate plans in their groups or class as a whole.

Allow about ten to twenty minutes for discussion. Go from group to group to keep discussion going. Make sure that each group has chosen a chairman to report to class.

The teacher should not attempt to ease the student's paths by giving answers. Instead, encourage students to research the questions thoroughly. Give students sufficient time to organize and articulate their thoughts even if at first it involves slow progression in the simulation.

A teacher's greatest contribution to an exercise of this nature is the creation of a classroom climate in which no student is afraid to take a chance on expressing any idea, no matter how unconventional it might seem at first. It may stimulate thought by all students.

Use the questions to make students conscious of the fact that the more they know about a subject, the better equipped they are to make critical decisions that will effect their city from this point on.

Students will not have immediate answers to all of the questions. The teacher should encourage research and progress with the program at each classes rate of completion of each part of the program.

It is always preferable for the students to stimulate their own thinking. Teacher suggestions should serve primarily to guide students' thinking.

Note:

Activity A is optional and is designed for a more detailed study of city government. It will be of particular benefit to a social studies teacher who wants to develop a more in-depth study than perhaps another subject area would have alloted time for.

CITY GOVERNMENT - ACTIVITY A

The teacher should encourage research, reading, and review in order for each group to familiarize themselves with the types of city government as a learning activity. The teacher should bring additional government textbooks into the classroom from the school library or social studies department for related reference materials.

Assignment:

After a review of the data, related materials, and a series of discussion questions, each group will select the type of city government that you feel best suited to carry out the objectives you have developed by your answers to the discussion questions.

Ask each student to review the following information in the data bank:

Forms of Government used in 3,193 cities over 5,000 population
(Pages 142-43.)
Phoenix Government chart (Page 147.)
Municipal Government outline (Page 147.)

Forms of Government of American Cities (Pages 142-43.)
Mayor Council Plan (Page 144.)
Commission Plan (Page 146.)
Council Manager Plan (Page 145.)

Students should be stimulated to think about the ways in which city governments can be compared. For example, under a discussion of leadership, students can be guided to think about the ways in which leaders are chosen in the different types. Are the leaders elected? Are they appointed? Under a discussion of decision making, students might consider to what extent individuals other than elected leaders influence political decisions.

The students should indicate what functions each official in their government will have. What official authority is granted or specifically denied to each.

In selecting an ideal form of city government for the future, each group should consider the following questions:

1. How will your government operate?
2. What advantages does it have over other types?
3. How will you solve the problem of costly overlapping services and confusing responsibilities that many city governments have?
4. Could you abolish county government and depend entirely upon city government at the local level?
5. How do you propose to inform the average citizen about his local government?
6. What special abilities and qualifications do you think the individual who holds office in your government should have?

Phoenix Tax Structure:

Note: If the teacher desires to further develop this unit into additional study on city government, a time period could be devoted to economic base of the city.

Students should review reference materials and data bank information such as:

Taxes (Page 140.)
Income (Pages 131-32.)
Land Ownership (Page 153.)
One citys annual expenditures (Page 141.)
Phoenix tax structure (Page 140.)
Sources of revenue for local government for 1950 and 1960 (Page 138.)
Proposed 1969-70 annual budget (Page 137.)

The following questions may be used as a framework for class discussion or group discussion to build an understanding to the economic base of the city.

Questions for discussion:

1. How will your government distribute the tax burden in the community?

2. Are there any services you would be willing to do without in order to reduce your tax bill?

3. Should churches and other non-profit organizations be required to pay taxes in your city?

4. Should persons who have no children in school be required to pay taxes to support the school program?

5. What services should the people receive for their tax money to justify the amount collected in taxes by your government?

(Estimated building costs in a major city for the year 1970.)

BUILDING COSTS

Elementary School (kindergarten to sixth grade for 800 pupils)	$ 3,000,000
Junior-Senior High School (with vocational facilities for 2,000 students)	10,000,000
Playground or Park	75,000
Public Branch Library	50,000
Community Center	100,000
Police Station	50,000
Fire Station	75,000
Hotel and Convention Center	30,000,000
Restaurant	100,000
Addition to University Hospital and Medical School (laboratories, wards, classrooms, dormitories)	6,000,000
Neighborhood Health Center	75,000
Small Nursing Home for Elderly	175,000
Single Family Home	15,000
Public Housing Project for 50 Families	1,000,000
Small Apartment Building for 40 Families	1,500,000
Small Store	50,000
Large Warehouse and Office	300,000
Small Shopping Center	600,000
Small Office Building	300,000
Small Factory	200,000
Parking Garage	100,000
Roads -- per 500 feet	20,000

CITY GOVERNMENT - Activity B

Students will work in groups and develop answers to the discussion questions, reporting back to the class as a whole to strengthen the learning experience. The number of questions considered each day will depend upon the time allotment and the interest each class initiates.

Questions.

Keeping in mind the goal of helping all city dwellers to enjoy decent, meaningful, and independent lives in your city of the future:

1. What type of city government do you feel is best to meet the particular needs of your city?

2. What conditions of life do you want to preserve and what do you want to eliminate?

3. What will be the effect of your city government as a whole on man's social institutions, organizations, and individual behavior? (Questions 2 and 3 may be excluded if considered in a previous activity.)

4. How will your city government be able to meet causes and consequences of urban growth, changes in population and industrial growth, likely to take place within the next fifty years?

5. How will your city government help the people prepare emotionally, psychologically, technologically for the future?

6. What provisions will you make to prevent crime against property?

7. What provisions will you make for the prevention of slums?

8. How will you provide for greater efficiency of land use and as much living space as desirable from an excavation site?

9. How will your city government keep young people from engaging in mischievious or lawless acts?

10. What controls and incentives will you provide for in creating attractive new residential areas? (such as control of utility lines, junk yards, billboards, garish signs, storefront clutter, removal of rubbish, cleaning of vacant lots, maintenance of buildings, fences, sidewalks.)

11. How does your government stand on the issue of preservations of a record of the past, such as acquisition of historic buildings and sites, landmarks, wilderness areas, dating from ancient Indian settlements.

12. What priority does your government have for building rehabilitation, curb and sidewalk installation, median island construction,

and street tree planting, bicycle paths, footpaths, parks, and recreation areas?

13. How will you provide for the efficiency of use of core facilities and curtail needless duplication of some facilities in outlying areas of your city.

14. How does your government stand on attracting new businesses to your area?

15. What does the citizen have in the decision making process of your government? How does your government restrict the freedom of the citizens? How will it enlarge their freedom? (in the discussion the students should point to such values as a belief in liberty, popular government, protection for the rights of all members of society, an orderly society, the right to have clean air, pure water.)

CITY GOVERNMENT - Activity C

The discussion questions may be used at the class level or if desirable, for group discussion. If used in groups they should report back to the class as a whole, how they answered the questions. This may be more effective if done each day, and covering only three or four questions.

As a result of the discussion the students should be more aware of what effects modern civilization has upon our natural world and how man fits into the overall ecological pattern of life. The students should be able to generalize that there are many causes for the deteriorating environment. They should realize that the solution to our environmental crises involves small measures by many people in accelerating sequence and also by a cooperative effort between the people and their government. The students should establish that protection of the environment must be a cooperative effort between the people and their government. They should also establish that pollution of one part of the environment affects all parts of the environment, however slight the pollution. The students may correlate saving the environment with control of modern technology. They may form hypothesis about coming to grips with the problems of our deteriorating environment at the level of the private citizen as opposed to "grand designs" of government.

In a class discussion, have the students analyze the problem of the relationship of government and the environment by discussing analytical questions.

Examples:

1. Where does responsibility lie for assuring the highest possible quality of life? Has protection of the environment been a cooperative effort between the people and their government?
2. Must efforts to solve the problems of a deteriorating environment result in a slowdown in economic growth and technological development?
3. What limits should there be, if any, on government action in the public interest aimed at controlling pollution, over population, and the use of natural resources?
4. What rights do people have to a more livable environment? Should there be a constitutional provision of a right to clean air, clean water, and quiet.
5. How does pollution of one part of the environment affect all parts of the environment, however slight the pollution?
6. Is there a fully effective way to save the environment without eliminating modern technology?
7. How have partial approaches to environmental problems tended to be more successful than "grand designs"?

8. Why is the demand for economic and technological progress a chief obstable to correcting the problems of our environment?

9. In dealing with the ecosystem have we passed the point of no return?

10. Why do we say that pollution is an international problem? Would it be a workable idea for the United Nations to outlaw environmental pollution?

11. Do developing nations tend to view environmental problems in the same way that developed nations do?

12. Why should people who live in towns with no industry be concerned with air and water pollution?

13. Why is pollution an important item in local, state, and national budgets?

14. Are ecological problems primarily problems between man and man or man and nature?

ENRICHMENT UNIT 8 - AIR

1. Conduct a class-wide, neighborhood, and/or city-wide survey of people as to:

    a) How has the air situation changed, if it has, over the past few years? Is this just an opinion or do they have facts to support their opinions?

    b) How can an individual tell that the air is changing - what evidences do they cite of increasing air pollution?

    c) Where do they think this air pollution comes from?

    d) What specifically would they recommend or be willing to do to alleviate this problem?

    e) How does your survey compare with specific sub-groups of the population - such as doctors, industrial officials, everyday citizens, air pollution experts?

2. Air Pollution Laboratory

Two basic things make up "air pollution". They are particles (often called particulates) and gases. Smoke contains both. The particulates are soot and dust. Some of them settle out and others float around until they are washed out by rain and snow or combine with other substances. Complicated equipment is needed to detect and measure the gases. In this exercise you will be measuring the particulates found in the air in your community.

Materials needed:

a) a map of the community
b) a wide mouth jar (gallon if possible)
c) distilled water (The initial amount will be supplied to you and if more is needed you may purchase it at any supermarket.)
d) a beaker or saucepan to evaporate water in
e) hotplate
f) Mettler balance

Procedure:

You and your classmates will be collecting samples throughout the community. Using a map, decide where the best places would be to place your collecting jars. The particles will be collected in your jars of water and then the water will be evaporated away and the particles left will be weighed. The experiment will last approximately four weeks.

a) Pour about a quart of distilled water in your jar. (If you are using a jar smaller than one gallon, fill it about one half full.) Mark the level of the water with a piece of masking tape or water-proof marker.

b) Label the jar with your name, date and location. You might like to identify your jar as a part of a pollution experiment from your school.

c) If possible, place the jar about five feet from the ground. Observe it every three or four days. Add more distilled water when needed to keep it from drying out.

d) At the end of the experiment, cover the jar and bring it to school being careful not to spill it.

e) Accurately weigh the beaker or pan that you will be using to evaporate the water. Pour the water into the pan. Rinse your collecting jar with distilled water and pour it into your pan too. (Remove any large objects such as leaves or insects.)

f) Evaporate the water slowly.

g) After the pan has cooled, weigh it and subtract the original weight from your new weight to find the weight of the particulates collected. Find your weight in milligrams.

Recording and analyzing data:

a) Measure the distance across the mouth of the jar to get the diameter in centimeters.

b) Take one-half of this number and multiply it by itself (Square the radius) and then multiply this number by 3.14. This now gives you the area in square centimeters.

c) Divide the weight of the particles by the area of the jar's mouth.

$$\frac{\text{weight of particles in milligrams}}{\text{area of jar's mouth in square centimeters}}$$

d) Multiply this number by 28.6. Now you know the number of tons of particles that fall on each square mile of your community in the time period tested. (28.6 is the conversion factor from milligrams per square centimeter to tons per square miles.)

e) Compare your figures to others collected from different areas.

3. Obtain a copy of the Maricopa County Air Pollution Control Program from the Maricopa County Department of Health.

4. What gaseous air pollutants are found in Valley air? Where do they come from? Document your answers.

5. Obtain copies of the State Health Department hearings on the mines' proposal to relax Arizona air pollution standards. What are these standards? How do they compare to the national standards?

    a) Conduct a debate on behalf of the mines and their contribution to Arizona air pollution? Investigate other factors in Valley air pollution.

b) How do electric power plants contribute to Valley air pollution? Set up standards for these polluters to adhere to.

c) What decisions did your committee reach as a result of this hearing and debate?

6. What do airborne particles look like?

As you set up in the previous investigation, you may have thought of some new questions. Here are some questions to answer in this problem. How big are pollution particles? Are there different kinds? Can you find out where they come from? Is the number of particles collected the same each day of the week? Collecting data to answer each of these questions is easy.

Materials:

a) map of the community
b) glass slides
c) clear plastic millimeter ruler
d) microscope
e) clothespins

Gathering Data:

Particles can be collected on a glass slide. Coat most of one side with a very thin layer of vasoline. Leave a clear place to pick it up. When this slide is exposed to air, particles will stick to it. Later you can observe these particles under a microscope.

You are responsible for collecting in one area. The class should agree on what areas to sample. Number the sampling areas on a communit map. Take your coated slide with you to sampling area.

Hang it on a string or clothesline with a spring-type clothespin, or lay it on a flat surface. Collect the slide after 24 hours. Mark down on it the date and the location.

Observe your slide through a microscope. Are the particles different sizes and shapes? Are they all the same color?

You should compare your sample of air pollution with others. To do this you need to know the average number of particles in an area on your slide. Here is how to find the average number; Without looking through the eyepiece, center the slide on the stage. Focus the microscope and count the number of particles you can see. The area of the slide that you can see at one time is called the "field". Record the number of particles in the field.

Now move the slide a short distance. Count and record the number of particles in the new field. Repeat this procedure several times. Make sure that you are looking at a different part of the slide each time. Now find the average number of particles in a field. Find the average by dividing the total number of fields you observed. Record this number.

You could compare your number with a classmate's. But the field of his microscope may not be the same size as yours. Therefore, you need to know the number of particles on a square millimeter of your slide.

a) First, measure the width of the low-power field of your microscope. Lay a clear plastic millimeter ruler across the microscope stage. Place it so that one of the millimeter lines can just be seen at the left edge of the field. Make sure that the ruler crosses the center of the field. You will be able to see a second line in the field.

b) The distance between markings is one millimeter. How many millimeters wide is your field? Estimate it. This total distance is the diameter.

c) Substitute this number in the formula below to find out the area in your field.

$$\frac{\text{diameter (mm)}}{2} \times \frac{\text{diameter (mm)}}{2} \times 3.14 = \text{area (mm}^2\text{)}$$

d) Now, divide the average number of particles per field by the area of the field. This will give you the average number of particles per square millimeter (particles/mm^2). Now you can better compare your slide with your classmates' slides.

Recording Data:

You should have already described the particles you saw and recorded your particle counts.

Now you can record your observations on the map of the community. Put down the particles/mm^2 and the date you exposed the slide.

Analyzing Data:

Where did you find the most particles? Did you find more on weekdays or on weekends? Can you explain the differences? Do the residential areas, highways and railroad tracks, industries and dumps make different amounts of air pollution?

From the size, color, and shape of the particles, can you infer how many different places they came from?

Present a report of your findings to the rest of the school and the PTA and city government. Perhaps the art teacher can suggest how to illustrate your report. Are you bothered by your data? Does it raise questions you would like to ask the people that govern your community? One way to get answers is to put these questions to the local newspapers. You can write letters to the editors and ask for answers to your questions.

Taken from Man and the Environment, pp. 358-362.

7. How does sulfur dioxide affect plants?

Air pollution makes it difficult to grow plants in or near a city. Only a few kinds of trees can survive in city air. Even in areas far from city air, smoke and smog are damaging trees. The smog from Los Angeles is killing 161,000 acres of pine trees in a national forest. Some of these trees are 115 miles away from Los Angeles! Christmas tree growers in Maryland may lose as many as 300,000 trees each year because of the smoke from power plants. Farmers in many parts of the United States are having difficulty producing crops. For example, smog harms lettuce, beets, spinach, and orange trees.

What happens to plants? Which parts suffer first? How long does it take to do damage? You can do a simple experiment to answer these questions. You will use a common source of air pollution - sulfur dioxide. It comes from burning coal and oil from mines. Power plants and heating systems of homes and apartment buildings put a lot of it into the air.

Materials:

a) at least 2 plants
b) a small container
c) large plastic bag for each plant; if the bags have holes, tape them shut.
d) tape
e) 2 grams sodium sulfite
f) 2 milliliters of 5% of sulfuric acid

Gathering Data:

A simple way to test the effect of air pollutants on plants is shown by enclosing the plant by the plastic bag and also putting under the plastic bag a small glass dish and taping the bag to the desk or demonstration table. You can make sulfur dioxide by adding sulfuric acid to sodium sulfite. CAUTION - THESE TWO CHEMICALS SHOULD BE MIXED ONLY IN A CLOSED CONTAINER. DO NOT BREATHE THE SULFUR DIOXIDE FUMES!!! Quickly seal the bag down on the desk after you have added the sulfuric acid to the sodium sulfite. What will be your control for this experiment?

Analyzing Data:

Combine your data with data of your classmates who used the same kind of plants. What conclusions can you draw from everyones' data? What general effects does sulfur dioxide seem to have on plants? Does the kind of plant you used seem to make any difference? Are plants with thick waxy leaves affected the same way as plants with long, thin leaves? Are young plants more or easily damaged than older plants? Do you think smog would affect house plants?

Get data on the incidence of sulfur dioxide in the atmosphere. When is it the highest? When would you expect the most damage to be done to plants from sulfur dioxide? How does the level of sulfur dioxide relate to the growing season in the Valley? Consult with farmers and find out if their plants have been noticeably affected by air pollution levels.

Supplementary Reading - Air

Air is the life blood of man. We can survive a few days without water, a few weeks without food. Our lifespan without air is reckoned in minutes. A few quarts of water per day are sufficient, but we need 35 gallons of air each day. Yet for all its vital importance, we treat air as though it were an unlimited resource which cannot be used up, contaminated, or otherwise altered. Painfully, the recognition is dawning that these assumptions are not correct; it can be polluted, it can be ruined.

The average citizen's knowledge about the atmosphere is distressingly small. Most of us do not recognize the crucial role of plankton in the ocean in producing oxygen, the role of forests in modifying climate, the role of winds in stirring the air, and so on. Similarly, scientific knowledge concerning climate and the effect of various airborne chemicals on human health is far from complete. There are many unanswered questions.

Another question that has been answered concerns the oxygen supply. Again, some scientists suggest that burning large amounts of fossil fuels, cutting forests, and the threatened reduction of ocean plankton by pesticides and oil spills would cause the oxygen supply to be used up and not replenished. While this possibility may still exist, current estimates indicate that it is very distant in the future.

Air pollution is now recognized as one of the most critical pollution problems because of its known effects on human health. The other forms of pollution may be equally serious, but the effects are not as well known. Air pollution is a quiet killer. Some illnesses develop twenty, thirty, or even forty years before becoming serious. Many of the illnesses are not killers, but only cripple or reduce a person's efficiency. The average American seems to have difficulty recognizing the possible effects on himself. Smoking, a similar phenomenon, without doubt has a number of adverse health effects. The effects of smoking are several times more severe than air pollution in most cities of today. Every day, additional people start smoking, others continue smoking, and the sale of cigarettes is legally permitted. Whenever the effects are distant from the cause, many of us develop a type of positive fatalism: "It will not happen to me. And even if it does, well, we all have to die sometime." Such attitudes inhibit any change that might eliminate some problems either in smoking or air pollution.

Sources of air pollution are numerous and varied, ranging all the way from minor sources such as cigarette smoking to major ones of burning fossil fuels (gasoline, oil, and coal) for power and heating. Another major source is in the manufacturing processes of a large number of industries -- steel, petroleum, chemicals, and many others. In volume, the largest source of air pollutants are motor vehicles -- automobiles, buses, trucks, and tractors -- all vehicles powered by internal combustion engines.

No locality in the United States is without air pollution today. No city, town, village, isolated mountain, or valley is entirely free from man-made air pollution. The primary differences are the amounts and type of pollutants in the air. Some predictions suggest it may be necessary to wear a smog mask in some major cities within a decade. Even now, children are told not to play outside on smoggy days in Los Angeles, New York, Washington, and other large cities, nor can they take physical exercises on such days. In a typical industrial city, twenty tons of dust fall on each square mile each month. The amount of air pollutants a person breathes in at street level in twenty-four hours in New York City is equivalent to smoking two packs of cigarettes. However, New York does not top the list. Tokyo has the dubious honor, where the cigarette equivalent is reckoned at three packs a day, and it is necessary at times to give policemen and other citizens oxygen.

The solutions are paradoxical. For example, the typical American cannot live without the automobile nor can he live with it. Our patterns of housing, shopping, employment, and recreation have been restructured by the automobile. Suburbs and shopping centers would have taken a much different form without the automobile. The automobile industry is one of the largest in the United States; the economy is dependent upon it.

Our industrialized, urbanized, extremely complex society would quickly collapse if all sources of air pollution were banned, effective tomorrow. For instance, there would be no electric power. Millions would become unemployed. Fortunately, the technology is available to alleviate some of the air pollution today. Devices are available to take much of the "smoke" out of the industrial smokestacks, to take the black smoke from jet airplane exhausts and others. Much remains to be done about the automobile. The electric car, if it were practical, would not eliminate pollution, as the batteries would have to be charged with electricity generated by burning soft coal or petroleum or by nuclear energy. Asbestos from the brake bands and rubber from tires are additional sources of air pollution.

As René Dubos pointed out in "We Can't Buy Our Way Out" in Part 1, many pollutants are not even recognized today, nor are the effects nor solutions known for many pollutants which are recognized. Most people think of air pollution as smoke from smokestacks and smog; however, modern air pollution is much more subtle than this. Frequently, it is invisible or nearly so.

Air pollution in the United States has been recognized as a major problem for several decades. It was recognized as a prime cause of twenty deaths and widespread illness in Donora, Pennsylvania, in October 1948. These killer fogs that result from air inversions are comparatively rare. However, when they do occur, they can rapidly reach crisis proportions. For every person who is killed directly in such tragedies, many others die permaturely as a result of lung cancer, bronchitis, or other respiratory illness.

Los Angeles has a long history of serious smog problems because of its unique geologic location. The city is in a roughly bowl-shaped valley that opens only to the ocean. Frequently, a cool layer of air traps the warm air, including exhaust fumes and other pollutants, on or near the surface of the valley.

Air pollution has been called to the attention of the nation for two decades. The Clean Air Act of 1963 was to alleviate air pollution. The act, not fully implemented today, authorized two new major federal activities: awarding of grants directly to state and local agencies to assist them in establishing or improving control programs, and federal action to abate interstate air pollution programs beyond the reach of individual states or cities. Additional legislation was enacted in 1965-1966 and later years.

Some of the necessary legislation has already been enacted; the major need is now to fund and enforce existing laws. The federal government has failed to give air pollution very high priority, at least in terms of monies appropriated. The annual amounts spent for research or enforcement has only been a fraction of the amounts authorized, which were themselves inadequate.

Taken from Society and Environment: The Coming Collision, by Rex R. Campbell and Jerry L. Wade, Published by Allyn And Bacon, Inc., 1972. pp. 125-127.

ENRICHMENT UNIT 9 - PESTICIDES

Pesticide Poll - Conduct a survey of your classmates and your block of their opinions about the following statements. Give reasons for choosing each opinion.

Opinions:
- A. Strongly disagree
- B. Disagree
- C. Neutral
- D. Agree
- E. Strongly agree

Statements:

1. Man should try to get rid of all the pests that threaten or bother him.

2. Keeping down weeds and insect pests in your own yard is more important than the little bit of poison you add to the environment.

3. The effects of pesticides on man must be well understood because the United States government has exact limits on how much pesticides are allowed in our food.

4. Farmers really shouldn't pay too much attention to all the effects of pesticides, because if pesticides work, that is all that counts.

5. I wouldn't mind buying food that was slightly damaged by insects, if this is the result of growing crops free of pesticides.

6. Recently a manufacturer has introduced a new shelf paper for kitchen cupboards. It has a pesticide on it that keeps insects out of the cupboards. If I had ants in my cupboard, I would put this paper on my cupboards.

7. If pesticides were really dangerous, the government would not allow them to be sold in supermarkets.

8. Passing laws to eliminate DDT will solve our pesticide problem.

Household Survey of Harmful Chemicals:

1. Conduct a survey as to all the potentially harmful chemicals to be found around your house. List completely the contents of each from the labels. Consult the *User's Guide to the Protection of the Environment* as to the toxicity and danger of each of these chemicals. Which ones are the most dangerous? the least?

2. Stores

    a. get a cross-section of different chemicals sold in a variety of stores - cleansers, soaps, pesticides, fertilizers, etc.

b. are there any restrictions on who can buy these chemicals?
c. how do you feel about these across-the-counter poison sales?

3. Exterminators

   a. Ask several exterminators what chemicals they use. Ask for specific chemical names.
   b. Ask the exterminators to explain the dangers of these chemicals with regards to toxicity, degradeability, etc. Do their comments agree with your references?

4. Farmers

   a. Conduct a survey of farmers - Baseline Road, Glendale, Chandler.
   b. What are the most often used pesticides and herbicides?
   c. How do these chemicals rate in safety?

5. How do farmers, exterminators, gardeners, housewives, state health officials, and you feel about the ban on DDT? Ask them to defend their position.

A Pesticide Dilemma

The small lagoon in Encanto Park is an oasis in the desert city of Phoenix. Rain water and artificial irrigation run off the land and feed the lagoon. Many fish, frogs, turtles, and birds live in or near the lagoon and depend on it for many forms of life support. Many people use the park for picnics and recreation. People who use the park sometimes complain about the large numbers of weeds in the area and in the lagoon. These plants are considered unattractive. For many people, weeds make the area less desirable than other places to picnic. The park department has been asked to solve the weed problem.

Any of the following suggestions seems possible:

a. Every year apply a cheap, fast-working weed killer. This will destroy the undesirable plants. Grasses may fill in the spots where the weed had been.

b. Ask everyone who uses the park to help dig up the weeds and plant more grass in the bare spots and help new more desirable aquatic plants to grow in the lagoon. This process, like spraying, would have to be repeated every two years.

c. Leave the area pretty much as it is. There may be a good reason for the weed growing there. Removing these plants by either method could have serious effects on the hills and the lagoon. The weeds themselves are not a serious problem. (How would you rate these plans?)

ENRICHMENT UNIT 10 - NOISE

Some Qualities and Kinds of Sounds (c. 1971, Dow Chemical Company)

1. Go with the class to several different areas of the school. Listen.
2. Have students do a similar exercise on sounds in their homes.
3. Have students describe in an essay the stounds they hear. Have them be very descriptive.
4. Make comparisons of sounds which are pleasant and which are unpleasant. Explain why they are pleasant or unpleasant.
5. Does Arizona have any standards or regulations on noise? If so, what are they?
6. Make a tape of acceptable and unacceptable sounds - Valley-wide.
7. Are noise--abatement regulations in effect at Sky Harbor? What are noise-abatement regulations? Why or why not? Obtain opposing viewpoints.
8. Do construction, traffic, people contribute dangerously to the noise levels in Phoenix? Why or why not? Back up your answer.

ENRICHMENT UNIT 10 - SOLID WASTE DISPOSAL

INVESTIGATION - The Biodegradability of Different Materials.

Materials: 1-2" deep plastic trays
earth to cover collected items

Procedure:

1. Collect items you consider important to the solid waste disposal problem in Phoenix.
2. Bury them in the pans under an equal layer of sod.
3. Investigate the condition of the materials at 1, 2 and 3 week intervals. Describe their condition completely in chart form.
4. Explain the reasons for the condition for each type of material. How can this be applied to the solid waste disposal problem in Phoenix? What implications do your conclusions have for sanitary landfills and recycling programs?
5. If the materials you tested are found in the city dump, do you think that the cities will be able to use dumps over and over? Why or why not?

Additional Activities

1. Collect data from the Phoenix Sanitation Department as to the amount of garbage and refuse collected in Phoenix, also indicating types and percent of garbage and refuse.

2. What are sanitary landfills? Where are they located? Draw up a list of factors to be considered in the planning, development, and ultimate use and re-use of sanitary landfill sites.

3. Project the needs, land, time, money, manpower for Phoenix for solid waste disposal.

4. Recycling is just beginning to be a factor in solid waste disposal. Formulate a city-wide program for the Sanitation Department to participate in a recycling program.

5. Gather information from Scottsdale's City Sanitation Department on the technique they are implementing in solid waste disposal innovations. What are some ecologically sound methods of dealing with the solid waste disposal problem?

6. Compost building - what is it? How could it be implemented with individual families, on a city-wide basis?

Student-Family Survey on Improving our Environment in the Valley

Instructions:

Many people express a great concern for our environment. All too often, however, they feel they can do nothing about it and it's someone else's problem. But each of us can do our part to help improve our environment. Following is a list of suggested ways we can help our environment and conserve our resources. With the help of your family complete this questionnaire by using the following responses.

1. We think this a good idea and are presently practicing this.
2. At the present time we are not doing this but we'll give it a try.
3. We don't do this and don't plan to either because it's foolish, we don't agree with the idea or don't think it's important enough to matter.
4. This item doesn't apply to us.

Water

1.____Repair leaky faucets (a slow drip can waste 15 gallons a day). To check for a leak in a water system, turn off all faucets and other outlets and watch the hand on the meter for 10 to 15 minutes. If it continues to move, there is a leak.

2.____Take showers instead of baths.

3.____Turn off water while shaving, brushing teeth, etc.

4.____Reset flush-o-meter toilets to use 3½ gallons instead of the normal 5 to 8 gallons per flush. Reset float or put one or two bricks in your tank.

5.____Run dishwasher only when you have a complete load.

6.____Keep water heater setting at 140 degrees F. (normal)

7.____Keep a bottle of drinking water in your refrigerator. Running water until it is cold could waste a gallon or more.

8.____Wait until you have a full nine-pound wash before running your washing machine.

9.____Follow manufacturer's instructions for detergent or soap. If you have a septic tank, using too much detergent may cause problems. Although phosphates are not a problem in the Phoenix area, they cause pollution in other areas. Encourage use of low-phosphate detergents.

10.____Avoid using disposable diapers. If you must use them, follow disposal instructions carefully.

11.____Avoid buying colored toilet tissue or paper towels. The dyes are not an excessive problem in the Valley but cause pollution at the paper mills and the water supply in those areas.

12.____Don't use paper towels where washable, reusable items will do the job.

13.____Don't flush away what you can put in the garbage, especially unsuspected cloggers such as cooking fat (give it to the birds), coffee grounds or tea leaves.

14.____Drain oil from power lawn mowers into a container and dispose of it. Don't hose it into the sewer system. It could be used as a weed killer in alleys and along fences.

Air

1.____Report any air pollution source by calling Operation Smog Stop at 274-1111.

2.____Motor vehicles are the major contributors to air pollution in the Valley. Keep your car in tune and in good working order.

3.____Ride a bike or walk short distances.

4.____Take mass transportation where available or form car pools if feasable.

5.____Show auto salesmen that you are concerned about the pollution the car you might buy will cause. (Be sure the car burns fuel efficiently (rates high in miles per gallon.)

6.____Limit smoking or stop altogether. It's a source of air pollution.

7.____Since fires, charcoal and gas barbecues add to air pollution, you should cease these practices.

8.____Burning leaves or garbage is illegal in many towns, including Phoenix. Don't do it. As a citizen, you can swear out a summons and bring a garbage-burning or noisy neighbor to count. Or, if you can gather a group of people, you can file a class-action suit against a noisy airline or negligent public anti-pollution official.

9.____Use appliances in off-peak hours. In summer avoid ironing, washing, etc., in the late afternoon when air-conditioning drains the most electricity. Using only the power you need helps conserve natural resources and minimizes pollution.

CHEMICALS

1.____Use pesticides and herbicides only when necessary, and follow manufacturers' instruction. Avoid DDT, lingering poisons, compounds of leads, mercury and arsenic. If your garden has water, sun, shade, and fertilizer, it may not need pesticides at all.

2.____Make sure fertilizer is worked deep into the soil. Don't hose it off into the water system.

3.____Patronize stores that specialize in food grown without pesticides. Campaign in your supermarket for the sale of foods grown without pesticides, using organic fertilizers.

4.____Don't dispose of chemicals or medicines in the sewer system.

5.____Use biodegradeable household cleaners, for example, vinegar and water for window cleaning.

RECREATION

1.____Do not litter, and don't tolerate it from others. A polite remark, I think you dropped something, should do the trick. If there is no trash recepticles where you are, pack up your garbage and bring it home.

2.____Try sailing, rowing or canoeing instead of motor boating. Use only the horsepower you need and don't dump leftover fuel in the lake or ocean.

3.____When hunting, don't leave shell cases or other remnants.

4.____Motocycles and four-wheel-drive vehicles should remain on existing roads and trails. Hikers and horseback riders should remain on trails, too.

5.____Make cleaning up an area a part of the outing. Leave the area in better condition than when you found it.

NOISE

1.____Fight to keep noise at a minimum at all times, especially between 11 p.m. and 7 a.m. Suggest that your local radio and television stations remind listeners at night to turn down volumn. To reduce noise of trash collection, buy a plastic garbage can instead of a metal one.

POPULATION

1.____Limit family size by producing only two children. If more children are wanted, adopt them or request that a foster child be placed in your home. (Information on birth control can be obtained through PLANNED PARENTHOOD ASSOCIATION OF PHOENIX, INC. 1200 S. Fifth Ave.) Answer this question first as it presently pertains to your family and secondly as you personally feel about the matter in your future.

2.____My own personal feelings about limited family size. (This answer would either be 2 or 3)

LEGISLATION

1.____Write letters to your governor, state senators, congressmen and other national legislators to let them know how you stand on environmental issues.

2.____Support legislation for vehicle inspection for auto emissions.

CONTAINERS

1.____Don't throw anything away that can be used again. When you shop, take a reusable bag (wicker, cloth, plastic) with you and don't encourage excess packaging and paper bag use. Don't take an unnecessary bag for a loaf of bread or a can of soup. Tell the supermarket checkers you don't want double bags if it is unnecesaary. Reuse all supermarket bags for garbage disposal.

2.____Participate in a recycling program if you know of a club or organization collecting materials.

3.____Plastic produce bags are offered in many markets. If you don't have a use for paper bags, take plastic bags and bring them with you for reuse the next time you go shopping.

4.____Avoid plastic bottles when possible. They do not decompose and some give off poisonous fumes when incinerated. Reuse the ones you have by filling them from glass containers, which can be recycled. If the product doesn't come in a glass container, complain to the manufacturer. When possible, use biodegradeable pasteboard, cardboard or paper containers.

5.____Avoid using plastic trash bags because they never completely decompose but are a minimal problem in landfill sites. They are broken into pieces and liquify due to the heat of decomposing organic matter.

6.____Hangers can be returned to the cleaners for reuse. Boycott a cleaner who won't take them back.

7.____Start a compost pile or bury biodegradeable garbage. It improves the soil and reduces the amount of solid waste to be collected, and disposed of by the city sanitation department.

(Taken in part from "Project En-fo", published by Valley Forward.)

PROJECTS

Collect materials which suggest that your city government is taking positive steps to meet the threats of technology and over-population.

What organizations in the city do you feel you should support to ward off the threats of pollution and over-population to your survival? Collect data on the organizations and evaluate their efforts.

Imagine in an essay what life would be like in the year 2000. Write a sketch of Phoenix in the year 2000.

Population control limits freedom, but so might over-population. Explain this statement.

Conduct a survey to determine, exactly, the extent to which you and your family pollutes the environment. Carefully study your house and make a list of everything your family adds to the air, water, or land that is a pollutant. Make suggestions to reduce individual and family environmental pollution.

Collect magazine and newspaper articles on environment and over-population. Underline the main facts in each article and be prepared to present a summary of the articles in front of the class when called upon.

Debates:

tax increases for new sewage facilities, public transportation systems, freeways, urban renewal and design
open space preservation - Phoenix mountains
restrictions on builders - urban sprawl
building sanitary landfills
increasing garbage service - recycling programs
birth control programs - abortion reference - city government support
required sex education in all schools
agriculture in the Valley - an expensive luxury? Water, land and pesticide use.

SUMMARY SYNTHESIS

Much of the educational value of SAVE will come out of the post-game discussion period, which can be left till the entire simulation has been completed.

The final discussion should be a review and synthesis of what has been learned in the complete activity. More than one class period may be necessary to do this.

The review class session is a post program meeting that is important to sum up the learning experiences. It is probable that issues and questions will have emerged that bear further discussion. (The teacher may wish to explore with students their possible attitudinal change after doing the simulation.) It is important that SAVE be seen not simply as a simulation but an involvement in the processes and human conflicts that arise in planning improvement of a city.

DATA BANK

For

Student Action For The Valley Environment

GEOLOGY

Land form

The Phoenix area and surrounding valley lies in a land form generally known as the "basin and range province". The province consists of numerous fault block mountains and the basins lying between them. Most of the blocks are long and narrow and are half buried in the sediment of alluvial fans formed along their straight bases.

Centuries of erosion caused by light rainfall and infrequent thunderstorms, along with generally mild winds with occasional sandstorms, created broad alluvial slopes extending from the base of the mountainsides. These slopes steepen as they approach the mountain base. The line of demarcation is distinct between the alluvial slope and the base of the mountain.

The mountains around Phoenix are composed of igneous and metamorphic rock. Geologic faults and nonconformities are common. The mountains are steep, barren, and impermeable to water. Rainwater rushing from the mountainside down natural washes create flash flooding problems in the valley.

Four mountain ranges surround the valley. They are the White Tanks to the northwest, the Sierra Estrellas to the southwest, the Superstitions to the east. The highest point in the valley is in the Superstitions at 5,025 ft. and the lowest point west of Phoenix, near Gila Bend with an elevation of 500 ft. Phoenix itself is at about the 1,100 ft. elevation.

In the valley proper there are two minor mountain ranges. The Phoenix Mountains to the northeast featuring Squaw Peak with its 2,600 ft. elevation and the Salt River Mountains commonly called the South Mountains comprise the local mountain terrain.

Soil

The soil is rocky and well drained except for some areas with a heavy clay base. It is reasonably fertile since they are rich in minerals and nutrients that have not been leached out by rains. The soil is alkaline or "sweet" and contains less than 1% organic matter.

Native desert soils form what is known as "desert pavement". This is characterized by a compact adhesive layer of soil. In its natural state, desert pavement is in a rather stable condition but if the surface is disturbed, wind erosion and dust storms can occur. Ground covers to prevent wind erosion and proper irrigation practices to prevent water from floating the minerals to the surface (leaching) are among the careful farming techniques necessary to protect the soil.

CLIMATE

Climatic Type

The condition of the Earth's atmosphere at any given time is referred to as weather. The overall weather picture for a long period of time is known as climate. When people say they move to Phoenix because of the weather, they should more correctly say it's because of the climate. Climate is the result of temperature, rainfall, humidity, wind and sun penetration over a long period of time.

Throughout the world many different climatic conditions are found. The three basic zones would be Tropical, Middle Latitude and Polar. Each of the major zones is further subdivided into more precise divisions. Phoenix lies in the Middle Latitude Zone and more previsely a Dry Continental Climate. Climates of this type are characterized by having under twenty inches of rainfall per year. This lack of rain is due to location on the leeward side of mountain ranges as in the case of Phoenix or great distances from the ocean or both. Also charactertistic of this climatic zone are hot summers, cold or mild winters, as in Phoenix and large daily temperature range. Where rainfall is under ten inches the area is more correctly called a "middle latitude desert". Phoenix is located in the Arizona-Sonoran Desert.

Temperature

The annual high daily temperature in Phoenix is 84.6°F. and the average low daily temperature is 55.7°F. Yearly average temperature is 70.1°F. A month to month breakdown of average highs and lows follows:

Month	Avg. Max. Temp.	Avg. Min. Temp.
Jan.	64.9°F.	38.0°F.
Feb.	68.9	41.7
Mar.	74.6	46.1
Apr.	83.0	52.5
May	91.7	59.8
Jun.	101.4	68.5
Jul.	104.0	77.1
Aug.	101.6	75.8
Sep.	97.7	69.0
Oct.	87.0	56.3
Nov.	74.7	44.9
Dec.	65.8	38.8
Annual	84.6	55.7

Figure 1. Monthly Temperature Range in Phoenix

Note that the above figures show the monthly changes are not great, some months being less than 3 degrees hotter than others and the greatest change less than 13 degrees. Daily highs and lows may vary as much as 30 degrees. This great variation within a twenty four hour period is characteristic of desert areas that lack water and vegetation which tend to help retain heat and stabilize the temperature. However, increased irrigation and residential development have added moisture to the air causing the nights to be a few degrees warmer than in years passed.

Urbanization has also caused climatic changes compounding the natural summer heat problem. The hard building surfaces absorb more heat than open ground and release it slowly during the evening. In addition, building masses break upwind currents which might otherwise carry heat away.

Humidity

The daily mean relative humidity is 49% in the morning, 31% at noon and 22% at 5:00 P.M. Throughout most of the year Phoenix enjoys a low relativity of 20-30% except August and September when it may rise as high as 70%. The amount of moisture in the air is rising as a result of more vegetation, more water on yards and the loss of moisture to the atmosphere by city surfaces. Relative humidity is being increased on the average of 3.8% per year. (This increased humidity reduces the effectiveness of evaporative coolers since they operate on the principle that as water evaporates into the air it cools the air around it. The amount of cooling is directly related to how rapid evaporation can take place, and therefore the more moisture already in the air, the less it will accept from the cooler and the efficiency decreases.)

Rainfall

Most of the rainfall in Phoenix occurs during late summer and midwinter.

During July and August, Phoenix experiences a "monsoon season". Monsoons being defined as seasonal winds is an appropriate description of what occurs. Subtropic winds moving in from the south bring moisture-laden air into the valley resulting in increased humidity. As the temperature increases during the day the warm moist air rises forming cumulus clouds. If the rising air cools sufficiently enough to form water droplets from the water vapor in the air, then a convectional thunderstorm will occur usually in late afternoon and evening.

The midwinter rains result from polar fronts moving in from the west with the prevailing winds.

The yearly average rainfall is 7.2 inches. A monthly breakdown is shown in the following chart.

Month	Avg. Rainfall In
Jan.	.73
Feb.	.85
Mar.	.66
Apr.	.32
May	.13
Jun.	.09
Jul.	.77
Aug.	1.12
Sep.	.73
Oct.	.46
Nov.	.49
Dec.	.85

Figure II. Average Monthly Rainfall in Phoenix

Ninety-five percent of all rainfall is lost due to evaporation and transpiration. (The national average is 70%) Only during December and January does precipitation exceed potential evapotranspiration. Due to this scant rainfall and the heavy usuage by an expanding population the sub-surface water table is lowering at a great rate. The alkalinity (salt content) is also increasing as we go deeper into the soil for our water supply.

Wind

Wind speeds in Phoenix are normally low with the average speed being only 8.3 miles per hour. Mountain - valley circulation causes wind to blow from the east northeast down the Salt River at night and from the west southwest up the river in the afternoon.

Normal convection currents rising from the hot valley floor cooling as they rise, tend to carry polluting materials upward with them. However, occasionally a layer of warm air will hover above the valley's cooler air, especially in the winter, bringing about a condition known as a "temperature inversion". When this occurs visibility is greatly lessened until a wind comes along with sufficient strength to blow away the "smog". (Smog is generally defined as a combination of smoke and fog. Since fog is not common in Phoenix and the Valley in general, the local air pollution should more correctly be called "smust" indicating a combination of smoke and dust.)

The following table shows the prevailing wind directions in Phoenix.

Prevailing direction	% of time
N	4.5%
NE	10.9
E	21.1
SE	14.7
S	5.3
SW	10.1
W	12.1
NW	7.0
calm	14.3
Total	100%

Figure III. Frequency of Wind Direction in Phoenix

Sunlight

Each year Phoenicians enjoy on the average of 228 clear days. The sun shines 85% of the time with a monthly breakdown shown in the following chart:

Month	Avg. % of sunshine
Jan.	77%
Feb.	80
Mar.	83
Apr.	88
May	93
Jun.	94
Jul.	84
Aug.	85
Sep.	89
Oct.	88
Nov.	84
Dec.	77
Yearly average	85%

Figure IV. Percent of sunny days per month in Phoenix.

Since the Valley experiences such an abundance of sunny, clear days it lends itself to heavy agricultural usage and is a popular tourist resort year round.

The shortest day of the year is the 21st of December, lasting about 11 hours while the longest day lasting 15 hours occurs the 22nd of June. The average sunrise is at 5:30 A.M. and average sunset is at 7:00 P.M.

Summary

If one were attempting to find an ideal location for a city, Phoenix would not be selected. Extremely high summer temperatures coupled with scant rainfall and possible flash flooding have resulted in turning away man's efforts to habitat the valley in centuries past. However, thru man's ingenuity and inventiveness he has overcome these obstacles and established a thriving, growing metropolis from parched desert land.

WATER

Background

The development of an adequate water supply system is one of the most vital necessities of every community. Water is required for sustaining life, safeguarding health, promoting sanitation, cooling air, providing fire protection, maintaining civic beauty, and the needs of industry, commerce, and agriculture.

Today, says the Geological Survey Division of the U.S. Department of the Interior, "the Salt River Valley is a principal part of the largest area of ground water overdraft in Arizona. Both surface water and ground water are inadequate for perennial irrigation. Ground water is heavily overdrawn...... Declines of ground water levels were as much as 150 feet in 1950-1960 and averaged about 50 feet in areas where ground water is the sole source of supply. The depth to the water table in 1960 ranged from 150 to 300 feet in most of the valley but was more than 400 feet in Phoenix. The salt content of the ground water is increasing as a result of 'return flow' of irrigation water."

In the Southwest, stream flow has always been too low to support irrigation beyond the modest usages of the American Indian. Yet the land holds the ingredients for a money salad: year-round sunshine and warmth, and soil full of natural fertilizers. The recipe lacks only water. This priceless catalyst is found underground in aquifers, water-filled deposits of coarse sand and gravel, or permeable sandstone, limestone, and dolomite. An aquifer is filled by surface water percolating down. In wet climates you can pump as much water out of an aquifer as the rains have put in without depleting your ground water supply. In arid regions, you are ill-advised (or a squanderer of your country's resources) to take more water out of an aquifer than nature can drip back in. In the perennially dry regions of the Southwest, it has taken nature thousands of years to fill the aquifers.

Unfortunately, what the Great Spirit has taken many millenniums to do, earth people can easily undo in a generation. Southwesterners are pumping away fresh water deposited deep underground in the last ice age, 10,000 years ago. "Mining" is a word that geologists use for removal of an irreplacable underground natural resource. The water will be mined dry in a few decades.

Present source of water

Since Phoenix is located in the Sonoran Desert its supply of rainfall is far from sufficient to provide the valley with adequate water. A look at the accompaning table will provide some insight into the water budget.

The P data represents rainfall in millimeters (There are approximately 250mm in one inch).

The PE data represents the potential evapotranspiration rate. Evapotranspiration refers to the surface evaporation of moisture combined with the moisture given off by plants by the process of transpiration.

Month	J	F	M	A	M	J	J	A	S	O	N	D	Yr.
PE	13	21	40	75	129	189	211	193	158	84	31	13	1157
P	21	19	17	10	3	2	25	27	19	12	15	21	191

Figure V. Water Budget expressed in millimeters of waters, Phoenix, Arizona

A comparison of the Water Budget figures shows that Phoenix must rely on outside sources of water to supply its needs. At the present time they come from two major sources.

Fourteen shallow wells located along the Verde River east of Phoenix and 75 deep wells in Scottsdale and west Phoenix along with diversion of impounded surface waters of the Salt and Verde Rivers provide 350 million gallons of water daily.

Phoenix lies in the Salt River drainage area. Except during very infrequent flood periods, no water flows in the Salt River channel in the Phoenix area. The reason for this is that large storage dams have been constructed on both the Salt River and its main tributary, the Verde River, for the purpose of storing irrigation water.

(A group of professors and students in the architecture department at nearby Arizona State University have embarked on a venture referred to as the Rio Salado Project. Basically, the plan involves the building of a dam west of Phoenix and allowing water to flow again in the Salt River bed. Land in the river bottom at the present time cannot be utilized to any great extent either for industrial or residential development, recreational activities and aesthetic enhancement could arise from what is considered by many to be an ugly scar running thru the city.)

Water Service Areas

Before 1920, several organized irrigation districts were created, to distribute surface water and ground water to the agricultural areas as needed. The largest irrigation district is the Salt River Valley Water Users' Association of the Salt River Project with some 250,000 acres. It initiated the development of the Phoenix area.

The city limits of Phoenix embrace about 160,000 acres, a large portion of which has been previously irrigated by the Salt River Project water from irrigation to municipal use, as irrigated lands are subdivided.

The City of Phoenix is currently serving considerable areas of land which does not have surface water rights both inside and outside the reservoir district; including: (1) the area south of the Highline Canal; (2) the bottom lands of the Salt River; (3) the Papago Park area; (4) the Arcadia area; (5) the Sunnyslope area; and (6) parts of Paradise Valley and Deer Valley. The remaining land is served by private water companies.

According to the City of Phoenix Water Department, all lands within the Salt River Reservoir District boundaries, that have water rights, will have an adequate source of water supply, well beyond the foreseeable future. Therefore, Phoenix's future need of water will be confined to land without these water rights, principally north of the Arizona canal.

The city of Phoenix Water Department has projected future water service area boundaries which encompass a large part of the Deer

Valley, Paradise Valley, West Phoenix and Southwest Phoenix areas. On the long range basis, wells in the southern part of the Deer Valley Area probably can be expected to continue to produce some water to support a small segment of the future population. However, it is the belief of the City Water Department that the Paradise Valley area will be in need of water importation before many years pass. Based on this lack of adequate local water supply plus future population fingures, it is estimated that by the year 2000 a large portion of the land not served by the Salt River Project will require many thousands of acre feet of additional water per year. Additional water from the Central Arizona Project will be needed to augment local supplies.

At the present time plans are being prepared to bring Colorado River water into the state via the Central Arizona Project. This project, although approved by the Congress, is yet to be funded. It appears, however, that by 1985 water from this source will be available at prices ranging from an average of $10 per acre foot at canalside for agriculture to $50-$60 per acre foot at canalside for municipalities and industry. The Secretary of Interior is clearly empowered to regulate the rates charged for the water by the project. The amount of water available will fluctuate between 330,000 to over 1,000,000 acre feet per year, which raises numerous problems of allocation among various interests.

Further questions arise concerning the overall economic feasibility of CAP water. The Arizona economy will clearly be unable to grow and prosper if prohibitive water costs are imposed by the CAP or other future water sources. The myriad alternatives possible in the Colorado River basin make clear that there is no single panacea for regional economic development, or even for water development. Building dams or "making the desert bloom" by bringing in additional water are no more than alternatives. The best cure for a threatening water shortage is not necessarily more water; savings in water use, or transfer of water use to less-consumptive, higher yield applications or discovery if new techniques of water management may offer better solutions. Indeed, if objectives are clarified, water development per se may not be the desired solution. It is time for the nation to draw upon its great reserve of scientific capability and consider how it can best meet the different objectives that people seek, instead of expecting new water projects to be the solution to all water problems. It seems clear that recent economic growth, in Arizona at least, has not been stimulated by irrigation and has not been impeded by water scarcity.

Additional water sources are under investigation. Throughout the world studies are being conducted on the effects of reverse osmosis, ion exchange, electro-dialysis, lime softening, and various de-salinization processes. Most of these methods at present appear quite expensive, but with future study the costs should be reducible through the discovery of more efficient operational procedures.

Perhaps the most applicable source of additional water for the Phoenix area may come from effluent reclamation. As much as 300,000 additional acre feet per year might be provided by prudent and co-operative handling of waste products. Broad research in addition to substantial financial investment, must be committed before an equitable water balance is realized.

FLORA AND FAUNA

Native vegetation

The native vegetation was long ago removed for irrigation and virgin desert vegetation is found only in the rocky hills and mountains. Exactly what type of vegetation would be found at any particular location depends on such factors as elevation, drainage condition and compass location on mountain slopes.

Plants that have become adapted for survival on the desert are called "Xerophytes". This word comes from two Greek words, "xero", meaning dry and "phyte" meaning plant. These plants have made many unique adaptations such as thick stems, deeply penetrating roots, modified leaves and thorns to enable them to utilize what little water they get to its fullest advantage.

Trees are usually small and are normally found in natural washes where they stand a better chance to capture the infrequent surface runoff water. Palo verde, mesquite and ironwood are characteristic trees found in the desert near Phoenix.

Bushes and shrubs are represented by the ever present creosote bush, cats-claw, crucifixion thorn, chaparral and white burr sage. A number of annual grasses are present, one of which is bear grass which catches fire easily.

Although people normally think immediately of cactus when they think of the desert, they are not really the most plentiful wither in total number of individuals or total tonnage of plant material per acre. Common cacti are the giant saguaro, teddy bear cholla or jumping cactus, barrel, fishhook, hedgehog, prickly pear, staghorn cholla and ocotilla.

Animal life

Most desert animals are active at night and hide underground during the day to escape the hot sun and blowing dust.

The mammal population, which is restricted by food supply, habitat and the presence of man, includes the bobcat, coyote, kit fox, coati mundi, ringtail cat and skunk as its carnivorous (flesh eating) members. Herbivorous (plant eaters) present are the javelina, blacktail jackrabbit, desert cottontail, packrat, desert chipmunk, kangaroo rat, round tailed ground squirrels, gophers, racoons, mice, and an occasional mule deer.

The Maricopa Audubon Society lists 54 species of bird inhabitants. Representative members of the bird population include the Harris and redtail hawks, eagles, elf owls, turkey vultures, roadrunners, gila woodpeckers, cactus wrens (state bird), gamble quail, whitewing, morning and Inca doves. These populutions vary according to season and moisture.

Reptile members include numerous snakes and lizards such as horned toads, Gila monsters, chuckwallas and gechos. Amphibian members are rare.

The arthropods are well represented by poisonous scorpions, centipedes, tarantulas and black widows and many harmless members such as grasshoppers, ants, wasps, bees, flies, spiders and praying mantises.

Facts About Phoenix Households:

1965 - 60% of households have children under 18
40,000 infants less than 2 years old
100,000 teenagers
3.84 persons per household

1967 - 59% of households have children under 18
median age only 23.0
median number of persons/household 3.5

1968 - 59% of households have children under 18
In 25% of households the youngest child is not over 5
42% of metropolitan Phoenix population is 18 years & under
median age 23.8

1971 - 55% of households have children under 18
43% of households have youngest child under 12
number of persons/households has declined in recent years, but average is still 3.2
25% of households have 5 or more persons

MEDIAN HOUSEHOLD INCOME
(Consumer Analysis Area)

1965	$6,787	1960	$6,062
1964	6,548	1959	5,690
1963	6,580	1958	5,636
1962	6,740	1957	5,249
1961	6,502	1956	5,136

INCOME 1965

District	Under $,3000	$3,000-$4,999	$5,000-$7,999	$8,000-$9,999	$10,000-$14,999	$15,000 & Over	Median
1	3%	9%	32%	23%	26%	7%	$ 8,681
2	0	0	5	2	26	67	15,000+
3	2	10	21	13	22	32	11,000
4	15	15	37	20	8	5	6,607
5	15	16	36	15	17	1	6,586
6	10	15	38	21	15	1	6,950
7	1	3	20	21	31	24	10,795
8	7	9	14	17	31	22	10,357
9	7	8	41	13	21	10	7,538
10	6	7	25	18	34	10	9,818
11	2	12	38	22	21	5	7,864
12	4	9	44	24	18	1	7,539
13	19	25	37	14	5	0	5,482
14	6	9	24	31	28	2	8,700
15	14	20	26	13	17	10	6,839
16	12	14	38	17	13	6	6,945
17	8	12	27	20	26	7	8,266
18	22	30	27	13	7	1	4,868
19	38	24	20	7	6	5	4,000
20	44	29	21	4	1	1	3,375
21	16	35	32	12	5	0	4,933
22	29	23	30	13	4	1	4,833
23	5	16	33	18	21	7	7,638
24	9	22	36	16	13	4	6,537
25	14	41	34	6	2	3	4,741
TOTAL AREA	14%	17%	31%	16%	15%	7%	$ 6,787
NUMBER OF HOUSEHOLDS	30,700	37,300	68,000	35,000	32,900	15,400	

MEDIAN HOUSEHOLD INCOME
(Consumer Survey Area)

1971	$9,392	1965	$6,787
1970	8,823	1964	6,548
1969	8,137	1963	6,580
1968	7,757	1962	6,740
1967	6,935	1961	6,505
1966	7,001		

HOUSEHOLD INCOME - 1971

District	Under $3,000	$3,000-4,999	$5,000-7,999	$8,000-9,999	$10,000-12,499	$12,500-14,999	$15,000-24,999	$25,000 & over	Total	Median
1	2%	4%	10%	11%	21%	15%	26%	11%	100%	$12,750
2	-	2	4	4	10	10	24	46	100	23,400
3	14	9	13	14	20	14	14	2	100	10,000
4	5	2	16	11	29	20	14	3	100	11,361
5	8	18	29	11	16	11	3	4	100	7,450
6	11	14	24	9	19	11	11	1	100	8,111
7	11	7	14	15	22	17	12	2	100	10,444
8	6	5	16	12	15	15	22	9	100	11,283
9	10	10	16	13	11	14	19	7	100	10,294
10	20	12	18	11	14	11	11	3	100	8,000
11	15	9	30	14	16	9	6	1	100	7,617
12	2	2	18	24	23	18	12	1	100	12,500
13	32	19	17	14	8	5	5	-	100	4,900
14	14	14	22	17	15	8	6	4	100	8,040
15	35	25	21	11	5	2	1	-	100	4,217
16	19	15	24	11	16	8	7	-	100	7,087
17	11	7	14	16	18	15	16	3	100	10,234
18	13	8	21	14	19	10	10	5	100	9,074
19	11	16	29	14	7	9	10	4	100	7,325
20	15	10	28	19	11	8	6	3	100	7,651
TOTAL AREA	12%	10%	19%	13%	16%	12%	13%	5%	100%	$ 9,392
PROJECTED NUMBER OF HOUSEHOLDS	39,000	32,000	61,000	41,000	51,000	39,000	42,000	16,000	321,000	

AGE BREAKDOWN - METROPOLITAN PHOENIX

	1960 U.S.Census		1970 U.S.Census		Change 1960-70	
Age Group	# persons	%	# persons	%	# persons	%
5 & under	98,232	14.8	103,012	10.6	+4,780	-4.2
6-13	116,305	17.5	164,138	17.0	+47,833	-.5
14-17	42,917	6.5	77,066	8.0	+34,149	+1.5
18-24	59,354	8.9	112,665	11.6	+53,311	+2.7
25-34	88,143	13.4	122,459	12.6	+34,316	-.8
35-44	92,581	13.9	109,515	11.3	+16,934	-2.6
45-54	71,281	10.7	106,033	11.0	+34,752	+.3
55-64	47,232	7.1	82,300	8.5	+35,068	+1.4
65-74	33,686	5.1	59,746	6.2	+26,060	+1.1
75+	13,769	2.1	30,588	3.2	+16,819	+1.1
Total	663,510	100.0	967,522	100.0	+304,012	
Median Age	26.7		27.2			

PHOENIX POPULATION DENSITY

	Population	Square Miles	Density
1950	106,818	17.1	
1951	109,000	17.1	
1952	119,000	18.9	
1953	130,000	21.0	
1954	140,000	24.1	
1955	155,000	29.0	
1956	170,000	35.8	
1957	179,000	36.3	
1958	242,000	52.6	
1959	364,000	110.0	
1960	439,170	187.4	
1961	452,000	189.8	
1962	468,000	220.2	
1963	483,000	222.7	
1964	494,000	222.7	
1965	504,000	245.7	
1966	519,000	246.2	
1967	533,000	247.3	
1968	544,000	247.6	
1969	565,000	247.7	

FACTS ABOUT PHOENIX POPULATION GROWTH

1965 -

Metropolitan Phoenix 900,000 people
53% of state's 1.7 million people
1/3 of area's households were not here in 1960

1967 -

Metropolitan Phoenix 930,000 53% of state's population
1967 40,000 person increase or +4.5%
1966-67 85,000 persons migrated into the area

1968 -

Metropolitan Phoenix 940,000
1968 34,000 person increase or +3.8%

1971 -

Metropolitan Phoenix 1,013,000 +3.7% increase
100,000 in-migrants 75,000 out-migrants

GROWTH STATISTICS

	1960-61	1969-70	1970-71
AREA (Square Miles)	191.1	247.7	247.9
POPULATION (Estimated January 1)	442,000	563,000	593,000
FULL-TIME GOVERNMENTAL EMPLOYEES (Per 1,000 Population)	6.3	8.0	8.2
POLICE			
Police Employees	618	1,122	1,272
Major Crimes (Crime Index Offenses)	13,200	29,626	32,000
Traffic Accidents	13,500	21,901	26,400
FIRE			
Fire Stations	21	30	30
Fire Alarms	6,400	13,225	13,500
STREETS			
Total Miles	1,496	2,084	2,146
Miles Cleaned	110,000	174,000	174,000
Miles Resurfaced and Sealed	42.2	280	300
TRAFFIC CONTROL AND LIGHTING			
Signalized Intersections	285	377	391
Street Lights	15,600	22,290	23,340
Miles of Major Streets Lighted	134.2	187	199
REFUSE COLLECTION			
Residences Served	160,000	198,500	203,000
Refuse Collected (tons)	200,435	289,000	316,000
SANITARY SEWERS			
Connections	90,000	165,000	170,000
Miles of Lines	965	1,920	1,980
LIBRARIES			
Book Stock	265,500	660,250	727,000
Circulation	1,418,789	2,283,400	2,397,600
MUNICIPAL PARKS			
Park Areas	48	103	106
School Playgrounds	92	121	122
Swimming Pools	14	19	20
Golf Courses	3	4	4
WATER			
Connections	122,073	167,800	174,000
Production (Billions of Gallons)	33.8	51.4	51.8
AIRPORTS			
Passengers Enplaned and Deplaned	864,000	3,000,000	3,000,000

PROPOSED 1969-70 ANNUAL BUDGET
Resources by Major Source--Appropriations by Major Function
(In Thousands of Dollars)

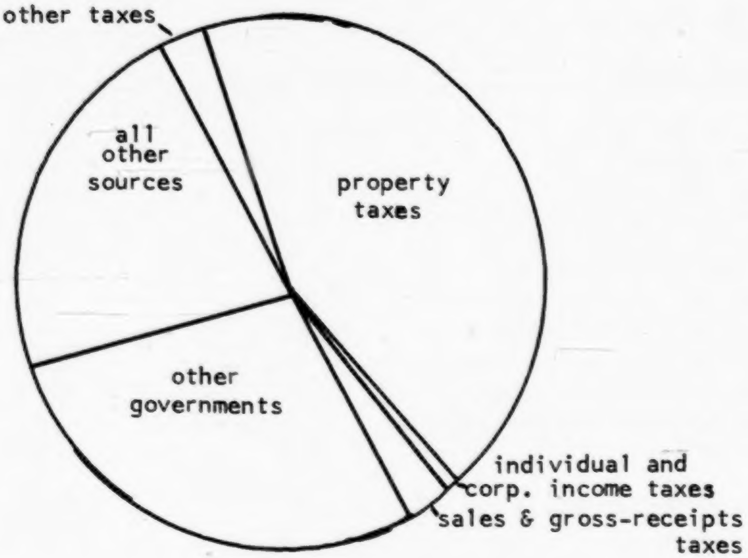
Resources

Source	Amount	% To Total
City Sales Tax	$17,910	30.2%
City Property Tax	11,751	19.8
State Sales Tax	9,490	16.0
Cigarette and Liquor Taxes	4,504	7.6
State Gasoline Taxes	3,671	6.2
Automobile In-Lieu Tax	2,231	3.8
Fines and Forfeitures	1,950	3.3
City Utility Transfers	1,628	2.7
Current Service Charges	1,623	2.7
Parks and Library Fees	905	1.5
Unrestricted Cash Balance	365	.6
All Other	3,325	5.6
Total Governmental	59,353	100.0%
Water System	14,450	
Airports	5,009	
Phoenix Civic Plaza	1,603	
Total Non-Governmental	$21,062	
GRAND TOTAL	$80,415	

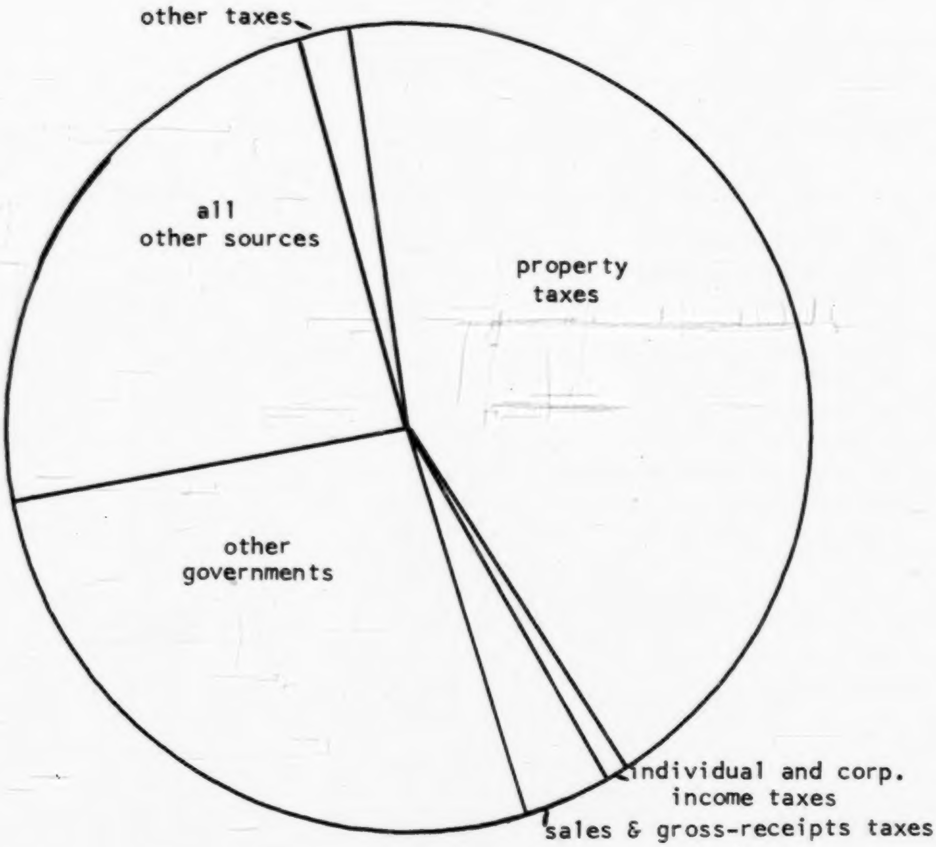
Appropriations

Function	Amount	% To Total
Law Enforcement	$13,555	22.8%
Streets and Highways	10,736	18.1
Sanitation	6,534	11.0
Fire Protection	5,978	10.1
Parks and Recreation	5,406	9.1
Sanitary Sewers	3,899	6.6
Public Works Services	2,728	4.6
Libraries	1,899	3.2
Building & Housing Safety	1,327	2.2
Contingencies	950	1.6
Community Services	466	.8
All Other	5,875	9.9
Total Governmental	$59,353	100.0%
Water System	14,450	
Airports	5,009	
Phoenix Civic Plaza	1,603	
Total Non-Governmental	$21,062	
GRAND TOTAL	$80,415	

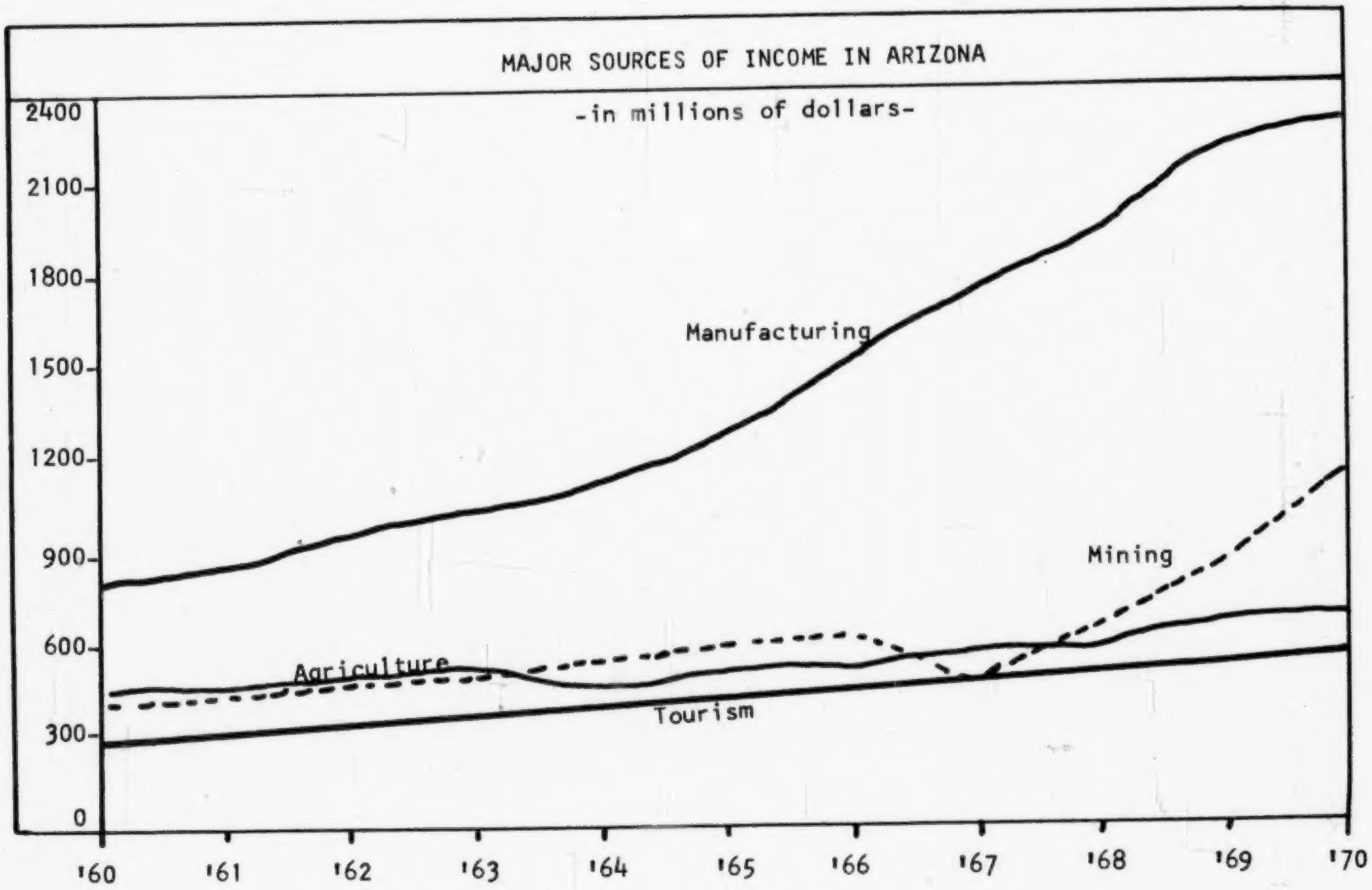
SOURCES OF REVENUE FOR LOCAL GOVERNMENTS: 1950 & 1960



1950 : TOTAL REVENUE : $16,101



1960: TOTAL REVENUE : $37,103



MAJOR SOURCES OF INCOME IN ARIZONA

-in millions of dollars-

PHOENIX TAX STRUCTURE

PROPERTY TAX

Estimated average tax rate for Maricopa County is $11.51 per hundred dollars of assessed valuation. This will vary, depending on the school district in which the residence is located.

SALES TAX

Arizona has a three per cent sales tax; in addition, the city of Phoenix levies a one per cent sales tax.

GASOLINE TAX

All funds from gasoline taxes, which amount to seven cents per gallon in Arizona, are allocated to street and highway improvement.

PERSONAL INCOME TAX

The scale for personal income taxes in Arizona is as follows:

First $1,000	2%
Second $1,000	3%
Third $1,000	4%
Fourth $1,000	5%
Fifth $1,000	6%
Sixth $1,000	7%
Over Sixth $1,000	8%

State income taxes are payable at the same time as federal income taxes. In Arizona, the sum of your federal income tax payments may be deducted before paying Arizona state income tax.

AUTOMOBILE TAXES

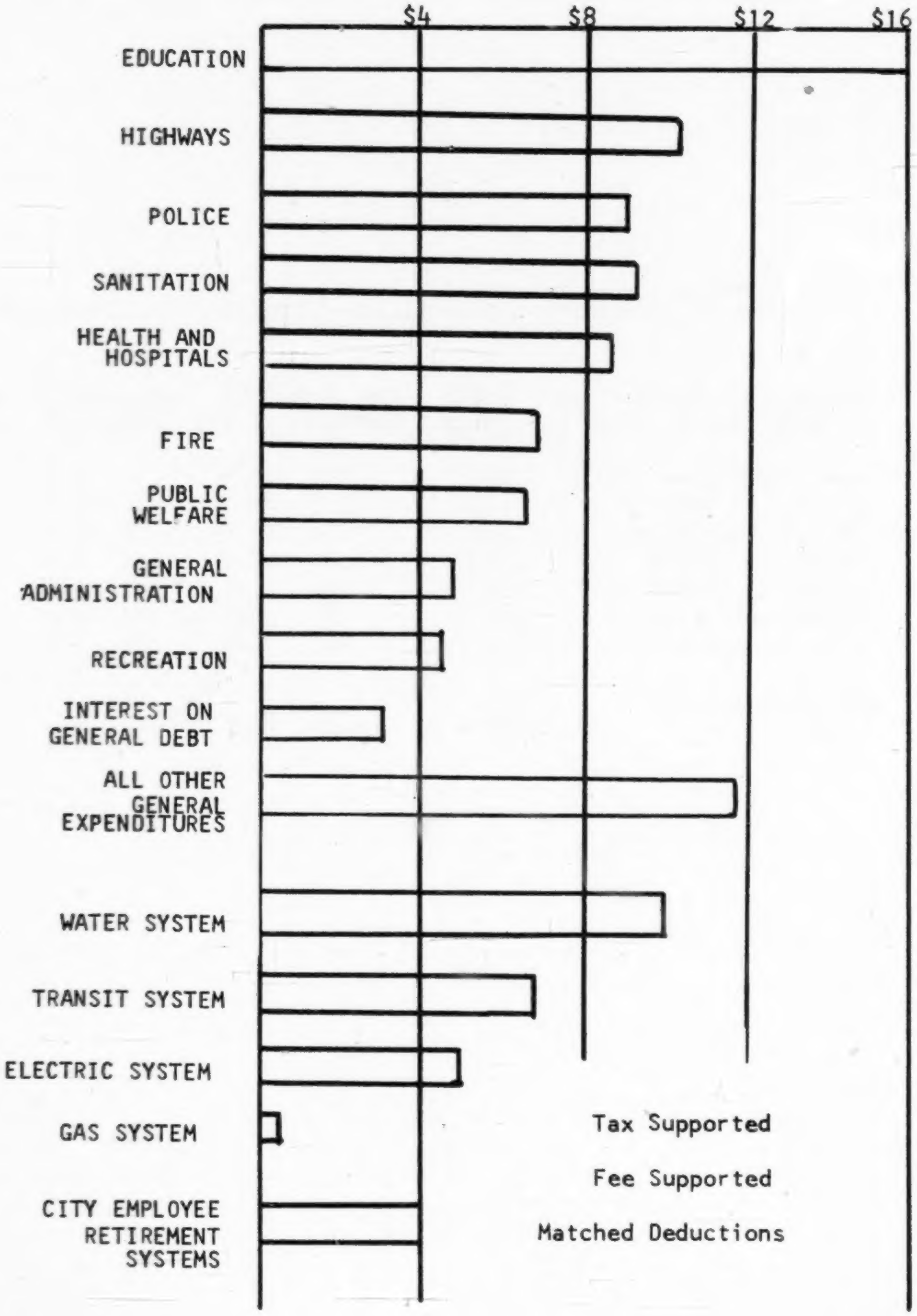
The state levies a flat registration fee of $6.25 per vehicle, plus an "in lieu" tax of four per cent of assessed valuation. It is the only state and local property tax on automobiles in Arizona.

DRIVER'S LICENSE and AUTOMOBILE LICENSE PLATES

Should you take a job or buy property in Arizona, or enter your children in a public school here - or when you've been in the state six months - you will need to register your car and obtain an Arizona driver's license. The driver's license fee is $2.50, and it is required that applicants pass tests on traffic laws, vision and driving. License plate fees vary with the make, model and year of car, and may be obtained at the county assessor's office.

ONE CITY'S ANNUAL EXPENDITURES

(in dollars per inhabitant)



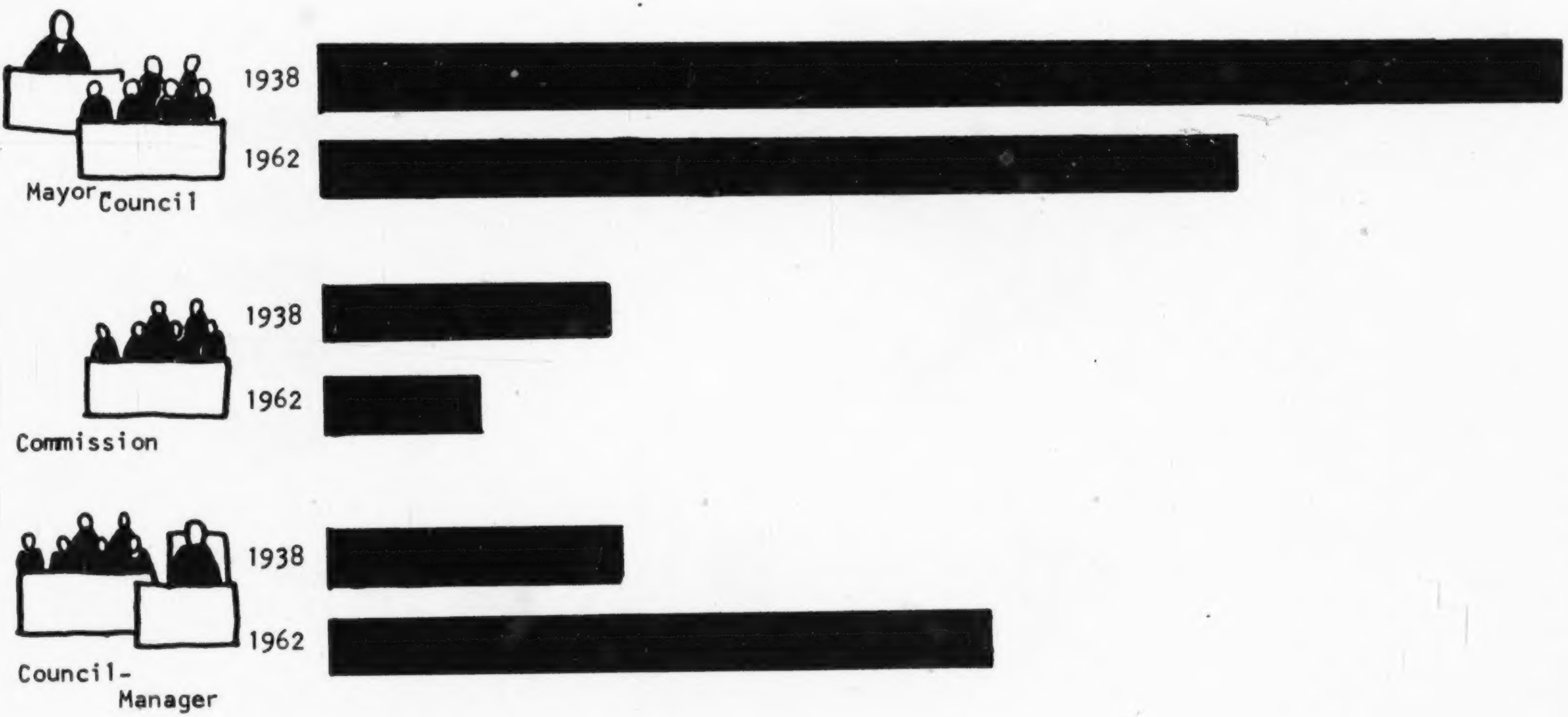
FORMS OF GOVERNMENT USED IN 3,193 CITIES OF OVER 5,000 POPULATION

Population Growth (1960 Census)	Total Number of cities	Mayor-Council		Commission		City-Manager	
		Number	%	Number	%	Number	%
Over 500,000	26	20	76.9	1	3.8	5	19.2
250,000 to 500,000	27	11	40.7	3	11.1	13	48.1
100,000 to 250,000	96	34	35.4	12	12.5	50	52.0
50,000 to 100,000	232	84	37.0	22	9.7	121	53.3
25,000 to 50,000	476	164	36.1	50	10.8	244	52.8
10,000 to 25,000	1,165	583	48.7	99	9.0	468	42.4
5,000 to 10,000	1,171	746	61.1	58	4.0	344	30.0
All cities over 5,000	3,193	1,662	51.8	245	7.9	1,245	40.3

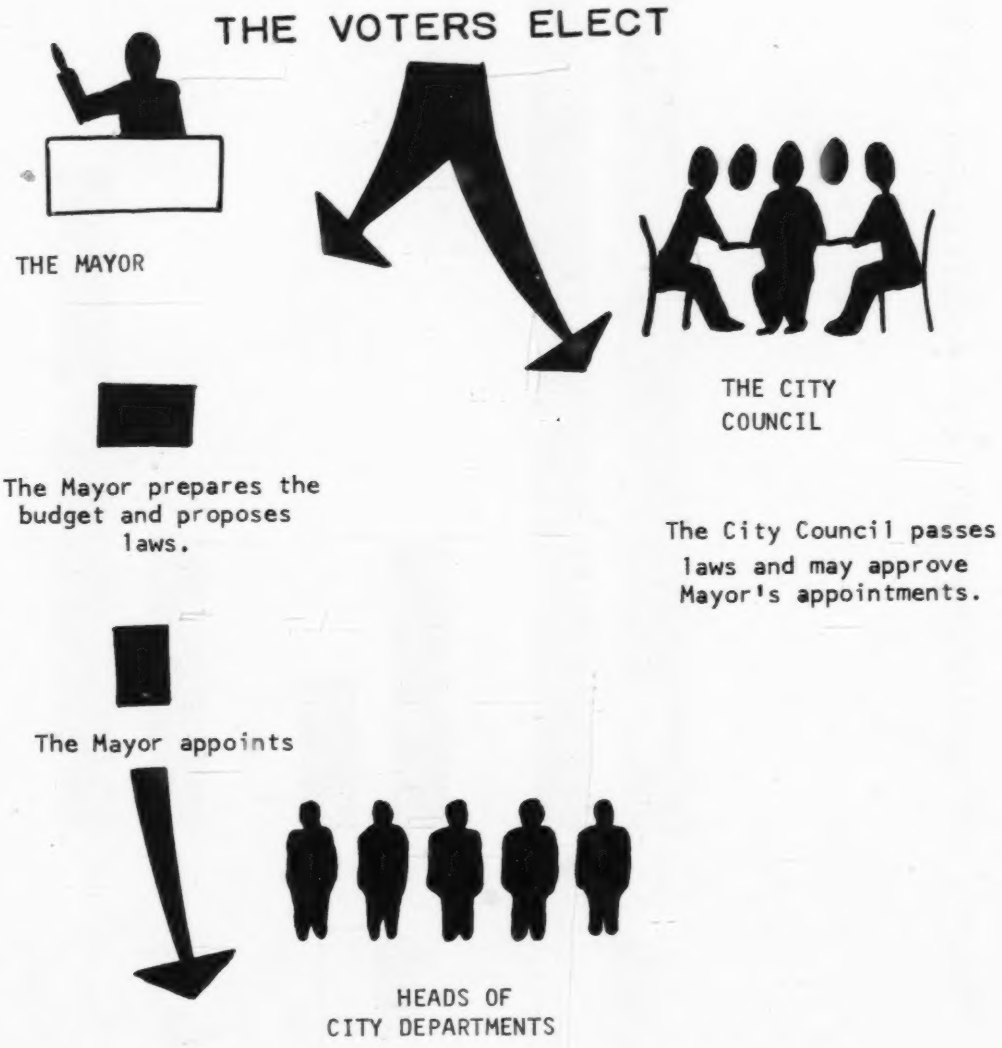
Municipal Yearbook 1966

FORMS OF GOVERNMENT OF AMERICAN CITIES

(Over 5000 Population)



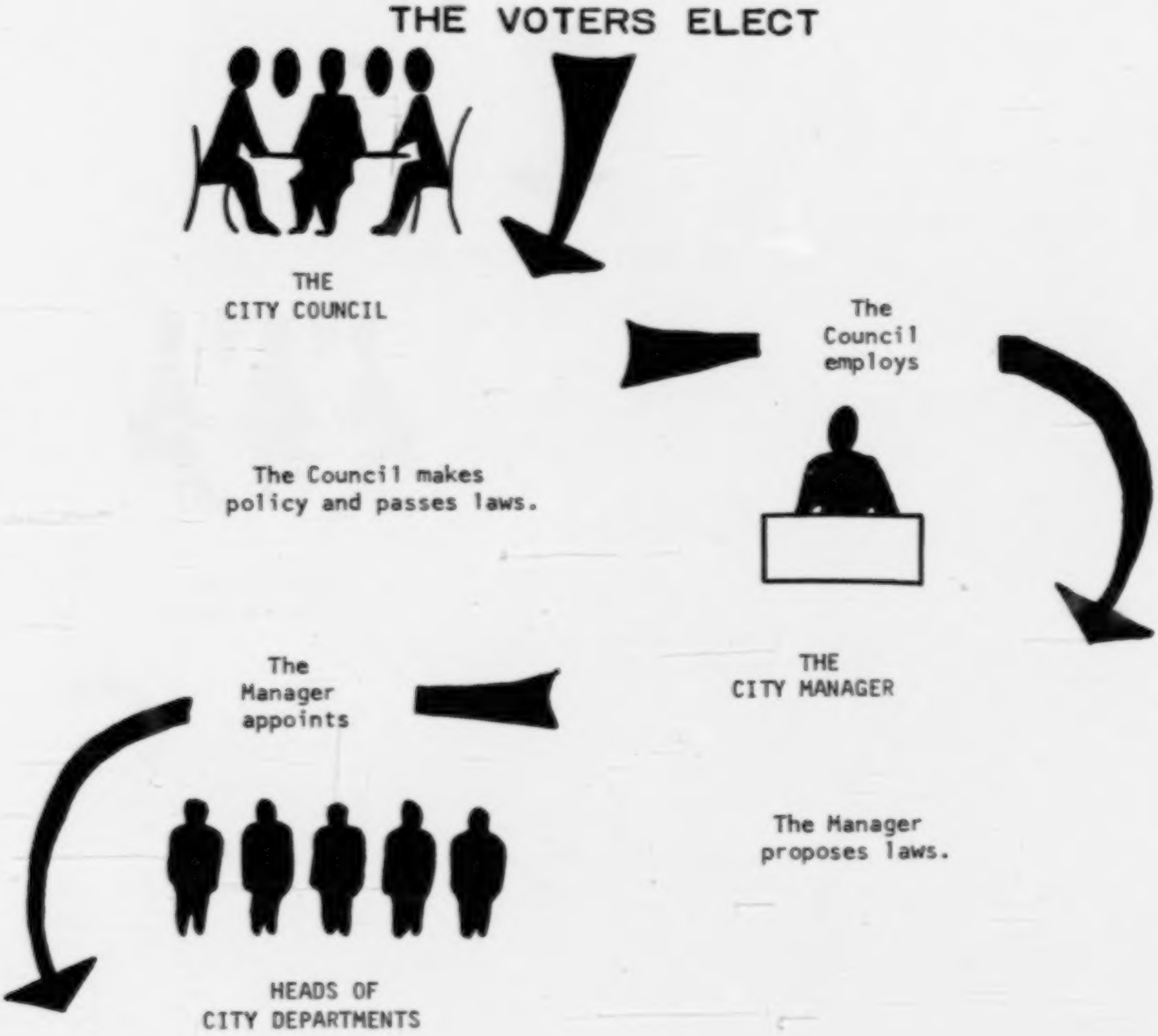
MAYOR-COUNCIL PLAN


THE VOTERS ELECT
THE MAYOR
THE CITY COUNCIL
The Mayor appoints
HEADS OF CITY DEPARTMENTS

The Mayor prepares the budget and proposes laws.

The City Council passes laws and may approve Mayor's appointments.

COUNCIL-MANAGER PLAN


THE VOTERS ELECT
THE CITY COUNCIL
The Council employs
THE CITY MANAGER
The Manager appoints
HEADS OF CITY DEPARTMENTS

The Council makes policy and passes laws.

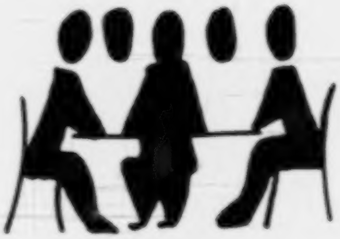
The Manager proposes laws.

COMMISSION PLAN

THE VOTERS ELECT

THE BOARD OF COMMISSIONERS

Commissioner of Finances



Commissioner of Welfare

Commissioner of Public Safety

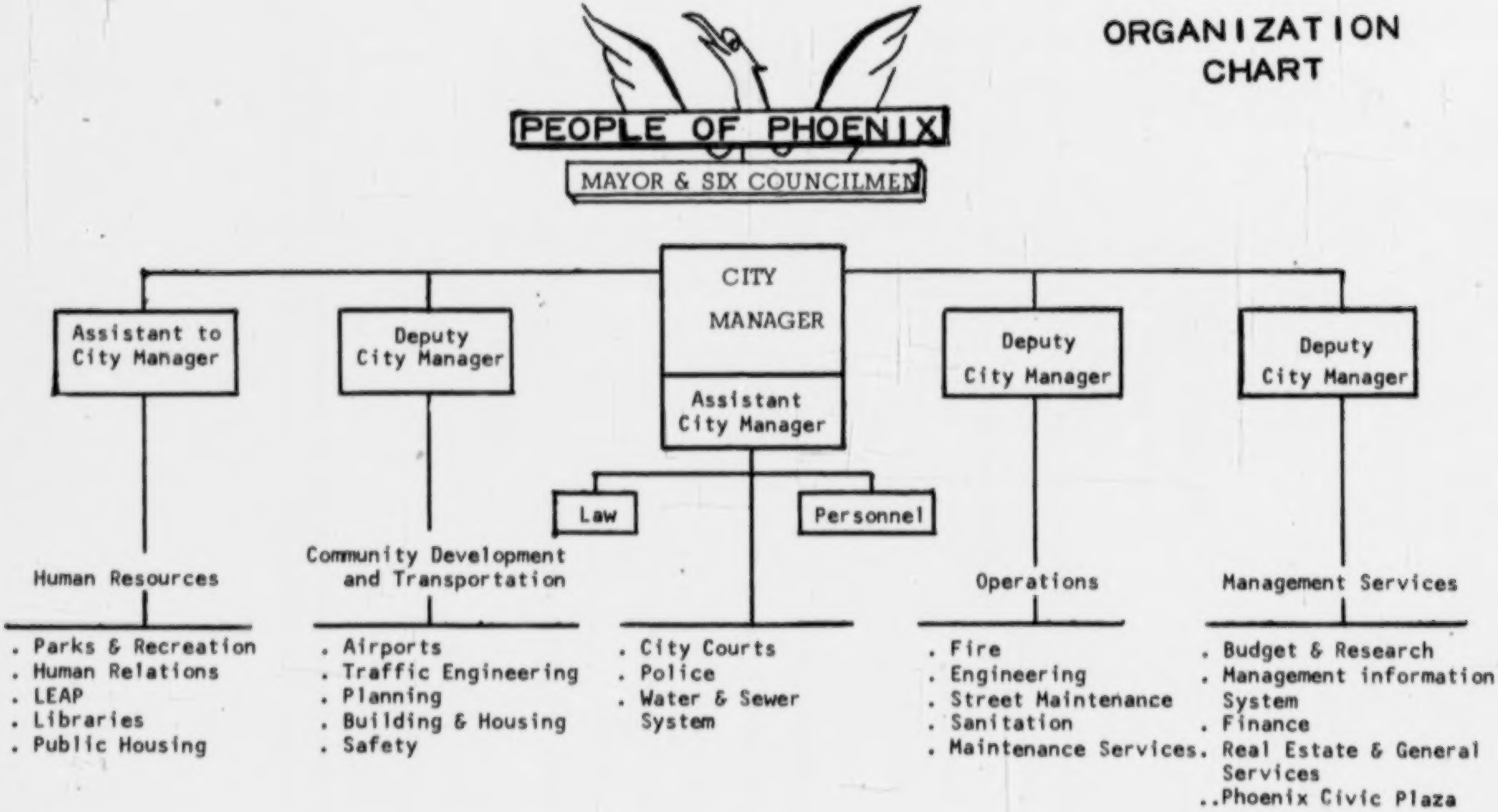
Commissioner of Health

Commissioner of Public Works

The Board of Commissioners acts as a city council. It passes laws and administers city government.

COUNCIL-MANAGER FORM OF GOVERNMENT

ORGANIZATION CHART


PEOPLE OF PHOENIX
MAYOR & SIX COUNCILMEN
CITY MANAGER
Assistant City Manager
Law
Personnel
. City Courts
. Police
. Water & Sewer System
Assistant to City Manager
Human Resources
. Parks & Recreation
. Human Relations
. LEAP
. Libraries
. Public Housing
Deputy City Manager
Community Development and Transportation
. Airports
. Traffic Engineering
. Planning
. Building & Housing
. Safety
Deputy City Manager
Operations
. Fire
. Engineering
. Street Maintenance
. Sanitation
. Maintenance Services
Deputy City Manager
Management Services
. Budget & Research
. Management information System
. Finance
. Real Estate & General Services
..Phoenix Civic Plaza

1965 AND 1990 LAND USE

Phoenix Planning Area

(In Acres)

Developed Land	1965	1990
Single-Family	28,927	63,300
Multi-Family	4,775	8,400
Commercial	3,135	5,400
Industrial	9,236	15,300
Railroads & Canals	1,169	1,200
Streets & Alleys	18,156	38,000
Parks & Recreation	18,296	29,100
Schools	1,809	3,600
Other Public & Semipublic	4,619	8,600
Total	90,122	172,900
Non-Urban Land		
Agriculture	60,220	13,300
Vacant	102,558	66,700
Total Land	252,900	252,900

LAND USE IN ACRES PER 100 POPULATION

Phoenix Planning Area

	PPA 1965	Phoenix 1965	Phoenix Less Major Mountain Parks (b)	Phoenix 1957	Tucson 1960	Average 5 Cities Over 250,000 Pop. (c)
Residential	6.5	5.5	5.6	4.6	4.9	2.0
Single Family	5.6	4.7	4.8	3.6	3.9	1.4
Two Family & Multiple	.9	.8	.8	1.0	1.0	.6
Commercial	.6	.5	.6	.6	.7	.2
Industrial	1.8(a)	.7	.7	.4	.2	.4
Railroads & Canals	.2	.2	.2	.1	.4	.2
Expressways, Streets & Alleys	3.5	2.6	2.7	2.6	3.3	1.3
Parks & Playgrounds	3.5	3.5	.5	.3	.5	.4
Schools	.4	.3	.3	-	-	-
Other Public & Semipublic	.9	.8	.8	1.2	1.2	.5
Total	17.4	14.1	11.4	9.8	11.2	5.0

(a) Included International Harvester proving grounds (4,400 acres)

(b) South Mountain, Papago, North Mountain and Squaw Peak Parks

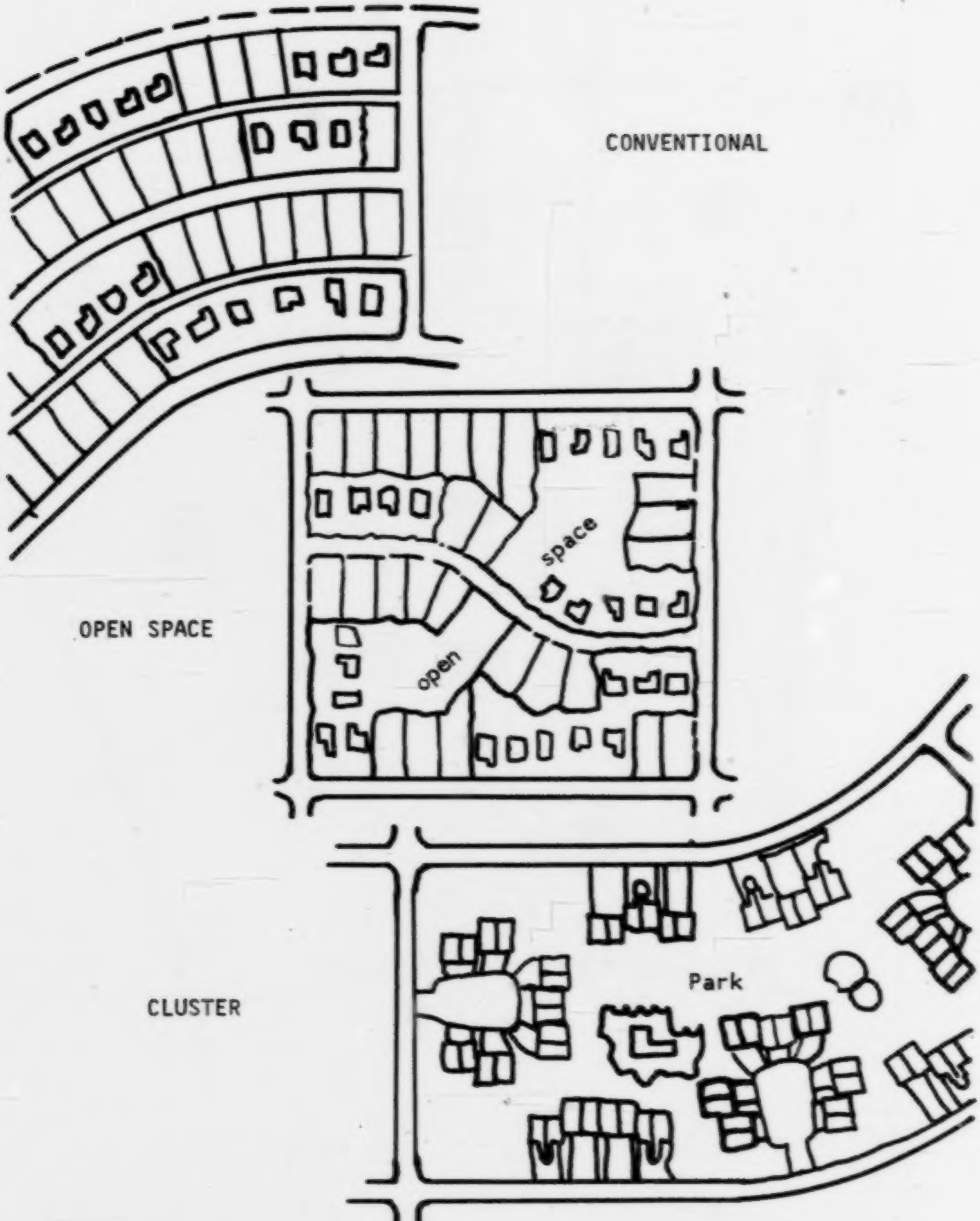
(c) Dallas, Texas; Dayton, Ohio; Memphis, Tennessee; Newark, New Jersey; and St. Louis, Missouri.

STANDARDS FOR FUTURE SHOPPING CENTERS

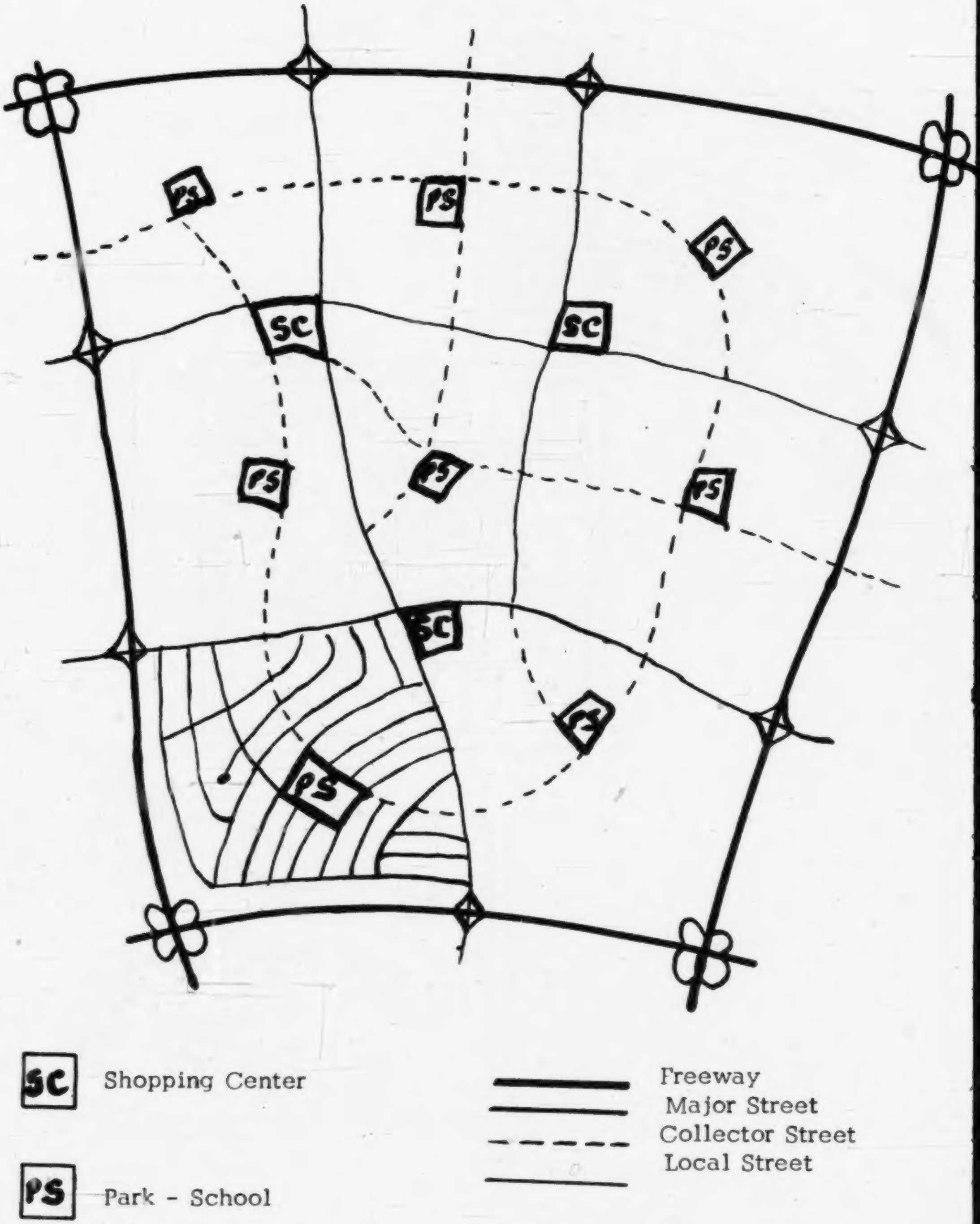
Type of Center	Neighborhood	Community	Regional
People Served	5 - 25,000	25 - 100,000	Over 100,000
Average Site Size	8 acres	22 acres	60 acres
Gross Square Footage	100,000	100 - 500,000	Over 500,000
Major Tenant	Supermarket	Junior Department Store	2 or more major Dept. stores
Area Served	Several Neighborhoods	Community	Major Districts
Acreage Needed to Serve Population	.8 acres per 1,000 persons	.5 acre per 1,000 persons	.4 acre per 1,000 persons

Sources: Community Builders Handbook, Urban Land Institute, 1968; Commercial Land Needs (Parts I, II and III), Santa Clara County Planning Department, 1964.

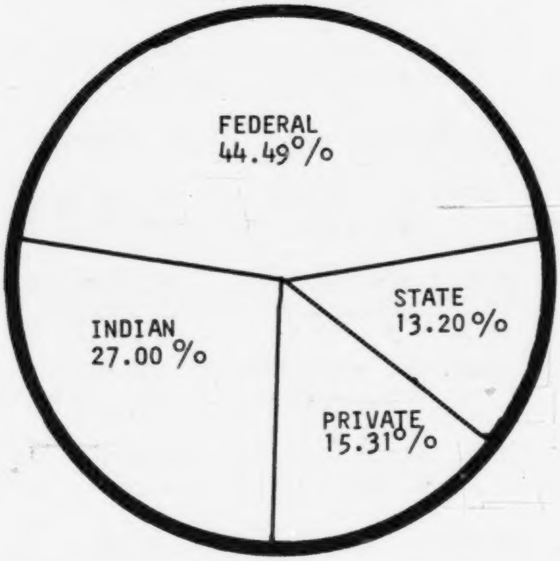
RESIDENTIAL DEVELOPMENT PATTERNS


CONVENTIONAL
open space
OPEN SPACE
Park
CLUSTER

MODEL NEIGHBORHOOD STREET SYSTEM


PS
PS
PS
SC
SC
PS
PS
PS
SC
PS
PS
SC Shopping Center
PS Park - School
Freeway
Major Street
Collector Street
Local Street

ARIZONA LAND OWNERSHIP



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